Before submitting, please review our editorial policies:
https://mbrjournal.com/2020/02/17/editorial-policies/
Please submit your manuscript at:
https://mbrjournal.com/submit-manuscript-2/

To get this issue of Management and Business Review (MBR) into the hands of as many people as possible, we request that you share this issue and the next with everyone you know. This issue is now available at the link below and, when it is published, the next issue will be too.

mbrjournal.com
Wallace Hopp, Christopher Ittner, and Kalyan Singhal.

Three editors in chief offer a bold vision for their journal: Management and Business Review (MBR). MBR is not just a new journal, it is a new kind of journal, one that seeks to empower business to transform the world for the good of all by facilitating more and deeper communication between management professionals, scholars, and students.

A Message from the Deans of MBR’s Sponsors.

The deans of its twelve sponsoring schools illuminate the intention that MBR’s diversity of sponsors and leaders should attract articles expressing a wide range of perspectives which it will then make widely available to business managers, scholars, and students. They go on to describe how, in order to further this mission of broad cooperation and sharing between businesses and educational organizations, MBR is offering a range of customization options.

Reimagining Capitalism.
Rebecca Henderson

What is capitalism? Is it the greatest source of prosperity and freedom the world has ever seen or a menace on the verge of destroying the planet and our society? The author argues that capitalism is the only solution to the massive problems that we face and explores the ways in which the private sector can help to reimagine capitalism so that it works for everyone.

Making Strategy Execution Work.
Christoph Loch, Stylianos Kavadias, and B. C. Yang

How do companies translate their strategy into operational actions that support it? Strategists use a different language than operational workers, and often the statements of the CEO have little connection with what the employees do. The authors suggest a tool that can help companies to align their employees’ actions with strategies, clearly explain that alignment, and encourage innovation from the bottom up and collaboration between departments, all in a way that can be completely customized.

Dave Ulrich

Consider how much the organizations where you live, work, and play affect your lives! In this short article, the author reviews the evolution of organizational logic, helping each of us to better appreciate our organizations and help them to deliver value.
Pay for Performance: When Does it Fail?
Nirmalya Kumar and Madan Pillutla

The consensus in social psychology is that monetary incentives for performance have a detrimental impact on individual performance. Yes, under certain specific and limited conditions, rewards can reduce performance. Yet pay for performance schemes are ubiquitous. How can we resolve this divergence between theoretical recommendations and observed practices? The authors recommend solving the problem by designing smarter incentives that avoid these detrimental effects.

Seizing the Moment: Having Difficult Conversations about Race in the Workplace.
Stephanie J. Creary

Conversations about race in the workplace have long been silenced. Recently, though, leaders have begun to fervently embrace such conversations. Drawing upon academic research, the author provides a framework for having difficult conversations about race in US workplaces.

Leadership as Craft - Crafting New Leaders.
Philip Mirvis, Karen Ayas, Jason Grenfell-Gardner

Leadership: Science, Art, or Craft? What is the best way to develop leaders? These questions are vital to the way leaders see themselves, enact their roles, and run their organizations. They present a range of choices to a CEO who needs to develop young leaders in order to grow a business. The authors address this question by describing a novel approach to developing effective leaders.

Leadership Development: A Psychologically-Informed Process That Spawned a Generation of CEOs.
Karol M. Wasylyshyn and Raj Gupta

The authors provide an in-depth look at a long-term leadership development process at Rohm and Haas that was dubbed “one of the best CEO universities” in the world. On a deeper level, they provoke reflection on the value of connecting holistically with high potential employees and on how, in doing so, we can maximize both human potential and business growth.

A Manager’s Dilemma: Sow or Harvest.
Vijay Govindarajan, Ashish Sood, Anup Srivastava, Luminita Enache, and Barry Mishra.

The authors have found that companies must focus relentlessly on building long-term competencies, even if doing so reduces immediate profits. Nonetheless, it is vital to shift focus when your product or idea becomes unexpectedly successful, so that you can milk that opportunity’s profits before it vanishes in the face of competition and technological progress.
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>Adaptive Space: Shifting from Structural to Social Design.</td>
<td>Michael J. Arena</td>
</tr>
<tr>
<td></td>
<td>One of the biggest challenges facing organizations today is the need</td>
<td></td>
</tr>
<tr>
<td></td>
<td>to be agile. To achieve this goal, leaders must seek a deeper</td>
<td></td>
</tr>
<tr>
<td></td>
<td>understanding of the power of social interaction in furthering the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>flow of ideas, information, and insight. The author explains how</td>
<td></td>
</tr>
<tr>
<td></td>
<td>building relational structures that foster 4D connections -</td>
<td></td>
</tr>
<tr>
<td></td>
<td>discovery, development, diffusion, and disruption - can usher in the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>new, innovative ideas and concepts necessary to positively disrupt.</td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>Learning from the COVID-19 Pandemic to Address Climate Change.</td>
<td>Howard Kunreuther and Paul Slovic</td>
</tr>
<tr>
<td></td>
<td>The COVID-19 pandemic has taught us lessons that can guide key</td>
<td></td>
</tr>
<tr>
<td></td>
<td>decision makers in both the private and public sectors toward</td>
<td></td>
</tr>
<tr>
<td></td>
<td>slowing climate change by reducing CO₂ emissions now. The authors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>explain how decision makers can design a risk management strategy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>that heeds the advice of experts and addresses the cognitive biases</td>
<td></td>
</tr>
<tr>
<td></td>
<td>which currently obstruct effective action.</td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>Boards and Sustainability: From Aspirations to Action.</td>
<td>N. Craig Smith and Ron Soonieus</td>
</tr>
<tr>
<td></td>
<td>Boards of directors can play a critical role in determining how</td>
<td></td>
</tr>
<tr>
<td></td>
<td>much attention their firms pay to sustainability. The authors explain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>how boards can turn their aspirations for sustainability into</td>
<td></td>
</tr>
<tr>
<td></td>
<td>meaningful action, particularly in light of the fundamental</td>
<td></td>
</tr>
<tr>
<td></td>
<td>questions boards should be asking in the wake of the COVID-19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>pandemic.</td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>Don’t Turn a Blind Eye to Environmental Violations.</td>
<td>Chris K. Y. Lo, Christopher S. Tang, Paul Zhou, Andy C. L. Yeung, and</td>
</tr>
<tr>
<td></td>
<td>Many firms believe that the way to cope with environmental</td>
<td>Di Fan</td>
</tr>
<tr>
<td></td>
<td>violations by their contract manufacturers is through</td>
<td></td>
</tr>
<tr>
<td></td>
<td>greenwashing initiatives which they hope will protect them from</td>
<td></td>
</tr>
<tr>
<td></td>
<td>collateral damage. The authors disagree, arguing that turning a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>blind eye to polluters in their supply chains can cause major</td>
<td></td>
</tr>
<tr>
<td></td>
<td>problems for firms.</td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>Climate Change: The Real Inconvenient Truth.</td>
<td>Yossi Sheffi</td>
</tr>
<tr>
<td></td>
<td>Consumers choose economic development over serious climate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>initiatives. Corporations don’t invest in meaningful change</td>
<td></td>
</tr>
<tr>
<td></td>
<td>because consumers won’t pay for it. And governments cannot lead if</td>
<td></td>
</tr>
<tr>
<td></td>
<td>citizens won’t follow. The battle to prevent climate change</td>
<td></td>
</tr>
<tr>
<td></td>
<td>through behavior modification, regulation, or personal deprivation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>has already been lost. The author explains why the solution is</td>
<td></td>
</tr>
<tr>
<td></td>
<td>collaborative investment in developing the carbon sequestration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>technologies that can reverse climate change.</td>
<td></td>
</tr>
</tbody>
</table>
The Case for Climate Optimism: A Response.
Kieren Mayers and Jonathan G. Koomey.

In response to Yossi Sheffi’s article, “The Real Inconvenient Truth,” the authors argue for the use of a variety of urgent measures to address climate change, rather than focusing primarily on long-term development and dependency on carbon capture and storage. Citing the now competitive cost of renewable power and the success of several countries in enacting programs that address climate change, they urge the need for optimism.

Response to a Response.
Yossi Sheffi

In a rejoinder to Mayers and Koomey, the author argues that, beyond sustainability theater, companies will never produce something that their customers will not buy or that they have to sell at a loss. Similarly, legislators will not enact substantial regulations contrary to the desires of their citizens, lest they be voted out of office. However, the author admits that carbon sequestration is expensive and unproven at scale.

Service Industrialization, Convergence, and Digital Transformation – I.
Uday Karmarkar

Digital technologies have significantly changed service industries, the largest segment of the US economy. The convergence of the creation, consumption, and delivery processes of services across a range of sectors, followed by rapid industrialization, has had a powerful effect on revenues, job shares, wages, and sector structure. The author explains why companies must respond to these challenges rapidly or risk being perpetual laggards.

Navigating Digital Turbulence.
George S. Day and Paul J. H. Schoemaker

When navigating the uncertainties of digital technologies, vigilant firms gain an edge by paying close attention to what is happening on their periphery and fostering organizational agility, so they are ready to act when the time is right. The authors examine three key principles that underpin organizational vigilance and show how Adobe’s leaders used them to great effect.

What Evolutionary Biology Can Teach Us About Corporate Reputation.
Paul A. Argenti and Ryan Calsbeek

The authors explain that corporations should focus not on their rankings, but on the attributes that influence those rankings. They combine evolutionary biology and corporate reputation research to determine what makes a company the best that it can be, arguing that a more scientific approach to corporate success is needed.
Leonard Kleinrock, Internet Pioneer.
Dr. Morten Bay

The emergence of the Internet has profoundly affected our existence and the world we live in. Rooted in the efforts of a small group of people who had a vision and performed the intense labor necessary to realize it, the Internet has grown into a technological movement born of the collaborations of its contributors. One of the essential early figures in the Internet’s history is Leonard Kleinrock. The author describes Kleinrock’s remarkable life and career as a co-creator of one of the greatest inventions in human history.

George Bernard Dantzig: The Pioneer of Linear Optimization.
John R. Birge

George Dantzig introduced the world to the power of optimization, creating trillions of dollars of value and saving countless years of life across the globe. In this laudation, the author describes the fascinating life and incredible accomplishments of a scholar whose footprints led the way to almost everything the global economy produces.

Enterprise Adoption and Management of Artificial Intelligence.
Thomas H. Davenport

Artificial intelligence is the most important new technology of the age, but it comes in many varieties, and businesses face a range of challenges in effectively deploying it throughout their organizations. The author takes a pragmatic but positive approach to AI’s long-term potential, describing effective approaches to creating and implementing a strategy for this transformative technology.

The New AAA Supply Chain.
Hau L. Lee

Agility, adaptability, and alignment (AAA) have long been key factors in the success of world-class supply chains. In recent years, changes in environments and natural forces pose new challenges. For those who wish to remain competitive, the author suggests that it is time to revisit these AAA capabilities to understand what they mean today.

Robert N. Boute and Jan A. Van Mieghem

By digitizing operations, companies may replace manual work with increased automation, but they may also augment human work through smarter execution. The authors present a conceptual framework that distinguishes the different levels of digitization, automation, and intelligence. This framework can serve as an audit, helping companies to assess where they are now and where they could be in the future.
The Cost of Capital: If Not the CAPM, Then What?
Ivo Welch

Twenty years ago, it would have been considered heresy to doubt the usefulness of the capital asset pricing model (CAPM) in assessing the cost of capital. The author argues that today, the CAPM should not just be doubted—it should be discarded.

Give Yourself a Nudge to Make Smarter Business Decisions.
Ralph L. Keeney

The author offers innovative concepts and practical guidelines for making smarter business decisions. They will help you to determine and define the decision you need to make, identify the complete set of objectives which your decision should achieve, and create a range of high-quality alternatives. Learn these skills to obtain the ultimate business advantage: making smarter decisions.

How Analytics Allowed the FCC to Save $7.3 Billion by Auctioning Underused Television Spectrum.
Subodha Kumar

Using an auction informed by analytics, the US Federal Communications Commission reallocated underutilized portions of the television spectrum. The revenue from this auction exceeded its cost by $7.3 billion, which went toward US deficit reduction. The author summarizes the Kiddoo et al. report on this groundbreaking work which won the 2018 INFORMS Franz Edelman Competition.
Praise for MBR

The Management and Business Review is a valuable addition to the world of business scholarship and analysis. I applaud leading business schools for launching this insightful publication.

David Rubenstein, Cofounder and Co-Executive Chairman, Carlyle Group

I’m delighted to see this caliber of international collaboration for a new kind of journal that brings the views and research of academics and business practitioners together. At a time when business leaders are faced with new levels of diverse and complex challenges that they need to solve, this will serve as a great learning resource from an impeccable roster of contributors.

Janet Foutty, Executive Chair of the Board, Deloitte US

This first issue is really superb! You have delivered everything you promised and more. Hard to think of a better way to start this ambitious project. Congratulations!

Kasra Ferdows, Heisley Family Chair Professor of Global Manufacturing, McDonough School of Business, Georgetown University

Congratulations on the launch of the new MBR journal. This initiative is important for the dissemination of insights obtained through academic research to the broader management community. It will support practitioners in answering the challenging issues they currently face and it will help us create value for society at large. I am really looking forward to reading the articles from recognized professors in top business schools around the world, which will challenge us to do better in the business community.

Ronnie Leten, Chairman of the Board of Ericsson and Epiroc, board member SKF Group

What an impressive way to launch MBR! The inaugural issue has an all-star lineup of contributors and is full of relevant and timely content. I have already selected several articles to pass on to the organizations I advise.

Steven Miller, Professor Emeritus, School of Information Systems, Singapore Management University

CEOs are expected to lead in entirely new ways, from ending systemic racism to providing solutions to COVID-affected communities. MBR delivers invaluable counsel and practical ideas, enabling CEOs to earn the trust of stakeholders who need business to fill the void left by government.

Richard Edelman, CEO, Edelman

MBR made a scintillating promise to the business and academic community -- and you have delivered in spades! The MBR layout and design is eye-catching and elegant, and most important, the
articles in the inaugural issue, individually and collectively, are a unique and powerful blend of applied thought-leadership and serious scholarship. 

Richard Ettenson, Professor and Kieckhefer Fellow in Global Marketing and Brand Strategy, Thunderbird School of Global Management

A new first-class journal linking management research and practice was long overdue. MBR is a solid and credible project led by an outstanding editorial team that will narrow the rigor-relevance gap.

Alfonso Gambardella, Bocconi University

I am happy to hear about the launch of the new Management and Business Review journal. The articles in its first two issues sound intriguing. I hope to send my new articles to MBR on the chance that they get included.

Philip Kotler, S.C. Johnson & Son Distinguished Professor, Kellogg School of Management, Northwestern University

I have followed the efforts led by Professor Kalyan Singhal to develop a new management journal, Management and Business Review, to bring a global perspective to cutting-edge research by faculty at the roughly 13,000 business schools worldwide. Kalyan is a spirited and determined entrepreneur who has built a strong team and drawn support from a wonderful array of business schools. I appreciate the value of increasing our publication opportunities beyond the Harvard Business Review, MIT Sloan Management Review, and California Management Review. I expect that one way that this new journal will distinguish itself is by focused inquiry into top global issues facing business and society.

Edward A. Snyder, William S. Beinecke Professor of Management and Economics, Yale University School of Management

Most academic management disciplines are primarily for professionals. Their first role is to help managers make more informed and insightful decisions based on good science. And yet most of our best journals focus on the science, not its application. Academics and managers alike should welcome Management and Business Review as a critical bridge in using our best knowledge to make decisions that lead to a better management and community environment.

John R. Roberts, London Business School and University of New South Wales

The world is in dire need of better-managed organizations. MBR delivers crisp, actionable managerial insights from a global network of experts and thought-leaders. MBR brings the best of leading edge knowledge in accessible language to those who can benefit from it the most. MBR is a fantastic initiative - read it.

Annabelle Gawer, Professor, University of Surrey and University of Oxford Saïd Business School

Welcome to Management And Business Review, a timely and relevant trendsetter journal delivering value through crisis management & innovation beyond research. A must-read journal where “the art of leadership blends with the science of management”

Bala V. Balachandran, Professor Emeritus, Northwestern University and Founder, Great Lakes Institute of Management, India

The launch of Management and Business Review (MBR), which is devoted to engaging articles that highlight recent research and its implications for burning management challenges of today and the future, is an important addition to the world of credible references and insights. MBR’s creation was a collaborative effort with a wide range of participant schools and companies, and as such promises to be broader in editorial scope than well-known journals in its class.

Dino Petrarolo, SVP, Competitive Capabilities International INC, South Africa
Advisors

- Regina Abrami, The Wharton School
- Ritu Agarwal, University of Maryland
- Raj Aggarwal, Kent State University Foundation
- Gad Allon, The Wharton School
- Edward Anderson, University of Texas at Austin
- Eugene Anderson, Syracuse University
- Paul A. Argenti, Dartmouth College
- Linda Argote, Carnegie Mellon University
- Anil Arya, Ohio State University
- Baris Ata, University of Chicago
- Rob Austin, University of Western Ontario
- Moloy Banerjee, Bangalore
- Felix Barber, Ashridge Strategic Management Centre
- Rajiv Banker, Temple University
- Richard Barker, Oxford University
- Caryn Beck-Dudley, Santa Clara University
- CB Bhattacharya, University of Pittsburgh
- Amar Bhide, Tufts University
- John Birge, University of Chicago
- Sam Bodily, University of Virginia
- Srinivas Bollapragada, General Electric
- Robert Bordley, University of Michigan
- Joseph Bower, Harvard University
- Tyson Browning, Texas Christian University
- Ryan Buell, Harvard University
- Andrew Campbell, Ashridge Strategic Management Centre
- Dennis Campbell, Harvard University
- Peter Cappelli, The Wharton School
- Jeff Cares, Alidade
- Glenn Carroll, Stanford University
- Bhaskar Chakravorti, Tufts University
- Richard B. Chase, University of Southern California
- Fangruo Chen, Shanghai Jiao Tong University
- Bruce Chew, Monitor Deloitte
- Sunil Chopra, Northwestern University
- Vidyanand Chouhdary, University of California, Irvine
- Bhagwan Chowdhry, UCLA
- Eric Clemons, The Wharton School
- Maxime Cohen, McGill University
- Morris Cohen, The Wharton School
- David Collis, Harvard University
- Charles Corbett, UCLA
- Stephanie Creary, The Wharton School
- Murray Dalziel, University of Baltimore
- Tom Davenport, Babson College
- George Day, The Wharton School
- David De Cremer, National University of Singapore
- Bert De Reyck, UCL School of Management
- Brian Denton, University of Michigan
- Preyas Desai, Duke University
- Suzanne de Treville, University of Lausanne
- Robin Dillon-Merrill, Georgetown University
- Jean-Pierre Dubé, University of Chicago
- Robert Eccles, Oxford University
- Omar El Sawy, University of Southern California
- Andreas Eisingerich, Imperial College London
- Jehoshua Eliashberg, The Wharton School
- Richard Ettenson, Thunderbird School of Global Management
- Paul W. Farris, University of Virginia
- Ken Favaro, act2
- Fred Feinberg, University of Michigan
- Kasra Ferdows, Georgetown University
- Charles Fine, MIT
- Baruch Fischhoff, Carnegie Mellon University
- Stewart Friedman, The Wharton School
- Alfonso Gambardella, Bocconi University
- Giovanni Gavetti, Dartmouth College
- Annabelle Gawer, University of Surrey
- Mary Gentile, University of Virginia
- Gerry George, Singapore Management University
- Stanley Gershwin, MIT
- Pankaj Ghemawat, New York University
- Anindya Ghose, New York University
- Ranjan Ghosh, Indian Institute of Management, Kolkata
- Itay Goldstein, The Wharton School
- Mark Gottfredson, Bain & Company
- Vijay Govindarajan, Dartmouth College
- Linda Green, Columbia University
- Rajdeep Grewal, University of North Carolina at Chapel Hill
- Yael Grushka-Cockayne, University of Virginia
- Alok Gupta, University of Minnesota
- Sushil K. Gupta, Florida International University
- Stefan Haefliger, City University of London
- Andrei Hagiu, Boston University
- Nicholas Hall, Ohio State University
- Gary Hamel, London Business School
- Warren Hausman, Stanford University
- Constance Helfat, Dartmouth College
- Teck Hua Ho, National University of Singapore
- Andrew Hoffman, University of Michigan
- Kartik Hosanagar, The Wharton School
- Arnd Huchzermeier, WHU-Otto Beisheim School of Management
- J. Jeffrey Inman, University of Pittsburgh
- Ravi Jagannathan, Northwestern University
- Anjani Jain, Yale University
- Dipak Jain, China Europe International Business School
- Karuna Jain, Indian Institute of Technology, Bombay
- Mansour Javidan, Thunderbird School of Global Management
- Nitin Gogekar, Boston University
- M. Eric Johnson, Vanderbilt University
- Ajit Kambil, Deloitte
- P.K. Kannan, University of Maryland
- Uday Karmarkar, UCLA
- Andrew Karolyi, Cornell University
- Sunder Kekre, Carnegie Mellon University
- Kevin Lane Keller, Dartmouth College
- L. Robin Keller, University of California, Irvine
• Stefan Thomke, Harvard University
• Brian Tomlin, Dartmouth College
• Alex Triantis, Johns Hopkins University
• Michael Trick, Carnegie Mellon University
• David Ulrich, University of Michigan
• Gregory Unruh, George Mason University
• Assoo Vakharia, University of Florida
• Andrew Van de Ven, University of Minnesota
• Jan Van Mieghem, Northwestern University
• Luk Van Wassenhove, INSEAD
• Rohit Verma, Cornell University
• J. Miguel Villas-Boas, University of California, Berkeley
• Eric von Hippel, MIT
• Richard Watson, University of Georgia
• Ivo Welch, UCLA
• Wulf Weller, Bain & Company
• George Westerman, MIT
• Seungjin Whang, Stanford University
• Andrew B. Whinston, University of Texas at Austin
• Jeffrey R. Williams, Carnegie Mellon University
• Yoram (Jerry) Wind, The Wharton School
• Patrick Wright, University of South Carolina
• George Wu, University of Chicago
• Houmin Yan, City University of Hong Kong
• Dennis Yao, Harvard University
• George S. Yip, Imperial College London
• S. David Young, INSEAD
• Fuqiang Zhang, Washington University in St. Louis
• Xiande Zhao, China Europe International Business School
• Feng Zhu, Harvard University
• Jerry Zimmerman, University of Rochester

Associate Editors
• Naren Agrawal, Santa Clara University
• Jennifer Blouin, The Wharton School
• Avi Carmeli, Tel Aviv University
• Arnaldo Camuffo, Bocconi University
• Maxime Cohen, McGill University
• Robert Davison, City University of Hong Kong
• Leander De Schutter, Erasmus University
• Kevin Desouza, Queensland University of Technology
• Jan Fransoo, Kühne Logistics University
• Vijay Gurbaxani, University of California, Irvine
• Murat Kristal, York University
• Yan Li, Essec Singapore
• Christos A. Makridis, US Council of Economic Advisers
• Amit Mehra, University of Texas at Dallas
• Kiran Panchamgam, Oracle
• Leyland Pitt, Simon Fraser University
• Stefan Seidel, University of Liechtenstein
• Mohan Sodhi, City University of London
• Ravi Subramanian, Georgia Institute of Technology
• Amrit Tiwana, University of Georgia
• S. Viswanathan (Vish) from Nanyang Technological University
• Michael Wade, IMD

Editorial Review Board
• Jaideep (Jay) Anand, Ohio State University
• Metin Çakanyildirim, University of Texas at Dallas
• Arnaldo Camuffo, Bocconi University
• Dave Chatterjee, University of Georgia
• Thomas Choi, Arizona State University
• Peggy Cunningham, Dalhousie University
• Timothy Choi, Arizona State University
• Varun Dutt, Indian Institute of Technology, Mandi
• Mark L. Frigo, DePaul University
• Bibhas C Giri, Jadavpur University
• Ronald Goodstein, Georgetown University
• Mary C. Lacity, University of Arkansas
• Ted London, University of Michigan
• Alan J. Malter, The University of Illinois at Chicago
• Jason Merrick, Virginia Commonwealth University
• Kyle B. Murray, University of Alberta
• Kiran Panchamgam, Oracle
• Elliot Rabinovich, Arizona State University
• Timothy L Smunt, University of Wisconsin, Milwaukee
• Yinliang (Ricky) Tan, Tulane University
• Andy Wu, Harvard University
• Zhibin (Ben) Yang, University of Oregon

Submissions
• Before submitting your paper, please review our editorial policies: https://mbrjournal.com/2020/02/17/editorial-policies/
• Please submit your manuscript at: https://mbrjournal.com/submit-manuscript-2/

Schools Publishing Customized Versions of the Management and Business Review (MBR)
• Fox School of Business, Temple University
• Haskayne School of Business, University of Calgary
• Merrick School of Business, University of Baltimore
• Ross School of Business, University of Michigan
Dedication

We gratefully dedicate *Management and Business Review* to the fond memory of Melanie Hopp

Melanie was a steadfast and courageous woman who encouraged and inspired her devoted husband, Wally Hopp, to strive to make the world a better place. A gifted teacher herself, she supported him in teaching and advising many students, in devising new educational programs, and in the planning and creation of *Management and Business Review*. We will continue to work to make this journal a monument to her intelligence and kindness. She is, and will ever be, sorely missed.

—*Management and Business Review* Leadership
Managemen and Business Review (MBR) is not just a new journal, it is a new kind of journal, one that empowers business to change the world for the better by facilitating more and deeper communication between management professionals, scholars, and students. This bold aspiration raises many questions for discussion, which we will explore in future editorials. But there are three which we feel it important to address in this inaugural issue.

1. **Why do we need a new journal?** There are over 30,000 academic journals publishing research on a vast array of topics, many of which may be of use to the millions of businesses around the world. At the same time, while there are hundreds of business magazines that are written and edited by journalists, few of these include articles by leading-edge management scholars. The handful of publications that do address the interplay between management research and practice cannot possibly disseminate the research insights of over 200,000 business professors, let alone those of professors from other disciplines and of leading management thinkers outside of academia. The situation clearly calls for a new journal which will bring management scholars and practitioners closer together worldwide.

2. **Why do we need a new kind of journal?** The existing business publications are each sponsored by a single university or firm, or have an editorial board dominated by journalists, or both. These characteristics limit their ability to identify and address critical issues in the immense domain of management research and practice.

   To explore this domain more thoroughly, MBR is structured like a platform rather than a centralized business. It is co-sponsored by twelve leading business schools, four of which are located outside the United States. It has a large and expanding editorial board that currently includes about 250 members, with leading scholars from dozens of universities, as well as managers and consultants from a plethora of firms. This board is design-edly decentralized, with more than thirty department editors currently authorized to accept papers.

   We expect this diverse and decentralized structure to generate uniquely varied and interesting content for readers and also to facilitate a review process, run by experts from a range of domains, which supports authors.

3. **How can MBR change the world?** Well managed organizations can serve a range of stakeholders, including customers, employees, shareholders, communities, and the planet itself, in countless ways. To help organizations to better serve their constituents, MBR is designed to: (a) publish articles that translate leading edge research
into useful insights and thereby help managers to elevate their practices, (b) publish overviews and discussions of pressing management concerns to help scholars select impactful foci for their research, and (c) bring the ideas of leading thinkers from academia and industry directly to students to enhance their education and help them to become better managers.

However, because of its platform character, MBR will depend upon the entire business and management community to achieve its goals. We need academic authors to express their vital research findings in clear, concise, non-technical language. We need business authors to describe challenges, experiences, and discoveries from the leading edge of management practice. We need editors to make sound decisions in recruiting and accepting papers. We need advisors to keep us all abreast of important topics. And we need readers, from students to professors to CEOs, to send us feedback on what they have read and what they would like to read. If we all work together MBR will be ever increasingly valuable to readers and authors alike. It will encourage scholars to work on the essential problems of managers and allow managers to transform research insights into practice. Together we will unleash the power of business and management to make ours a better world.

We hope you will join us on this exciting journey. MBR and the world need you.

Wallace J. Hopp is the C.K. Prahalad Distinguished University Professor of Business and Engineering at the University of Michigan. In recognition of his research on manufacturing, supply chain, and health care systems, he has been elected to the National Academy of Engineering, and is a Fellow of IIE, INFORMS, MSOM, POMS and SME. He has served as President of the Production and Operations Management Society (POMS) and as Editor in Chief of the journal Management Science.

Christopher Ittner is the EY Professor of Accounting and Chair of the Accounting Department at The Wharton School of the University of Pennsylvania. He earned his doctorate in Business Administration from Harvard University. Dr. Ittner’s research and consulting focus on the design, implementation, and performance consequences of cost management and performance measurement systems. He has served as an Editor for The Accounting Review and sits on the editorial boards of several international academic journals.

Kalyan Singhal is the Doris and Robert McCurdy Professor of Management at the University of Baltimore. He is a 1967 mechanical engineering graduate of the Indian Institute of Technology, Bombay at Mumbai. He founded the Production and Operations Management Society (POMS) in 1989. He also launched the society’s journal Production and Operations Management in 1992 and has since served as its Editor in Chief. He is the publisher of this journal and a Fellow of INFORMS and POMS.
A Message from the Deans of MBR’s Sponsors

We are proud to sponsor Management and Business Review (MBR) and excited to welcome you to its inaugural issue. As business school deans we believe passionately in the immense power of business to fulfill the needs and aspirations of humanity. As educators we believe that discussion and debate are central to individual and societal growth. By publishing articles that are grounded in research but focused on practice, MBR will stimulate critical discussions about how business can better serve us all.

But if this stimulus is to produce results, our discussions must be broad and inclusive. That’s why MBR is sponsored by twelve schools on three continents, led by three editors in chief from three different institutions, and guided by an editorial advisory board of about 250 members from a wide range of institutions in Asia, Europe, and the North America. This diversity of sponsorship and leadership is intended to attract articles that address the varied gamut of concerns facing businesses and societies around the globe and to distribute those articles to a similarly wide range of managers, scholars, and students.

As you can see from this impressive first issue, the editorial and advisory team has done its part to inspire rich discussions. Its members have solicited and edited scintillating articles from great thinkers throughout the spectrum of management disciplines. They have gathered content well worth reading. But broad discussions are not borne of content alone; that content must also be read by a broad audience.

This is where we need you. MBR was founded as a grassroots initiative and must also grow as one. In this spirit, we invite all members of the business community, worldwide, to share this issue with colleagues or anyone else who might be interested. The first two issues of MBR are completely free in digital form and can be shared via email, social media, or online post.

To promote sharing within businesses and educational organizations, MBR is offering a range of customization options. These options include special editions co-branded with your school or company. MBR can even be customized to include special content tailored for your organization. This customization will strengthen your relationship with your constituents and elevate your brand. For a short time, MBR is also offering special pricing on customized options. Please contact Coeditor in Chief Kalyan Singhal at <Ksinghal@ubalt.edu> to discuss pricing and customization options.

We especially encourage our fellow business school deans to take full advantage of MBR. In addition to sharing these free issues with your faculty, students, alums, and industry affiliates, we urge you to share them with a broader range of university stakeholders. Given that students from a diverse set of disciplines and majors ultimately go into business, sharing MBR with a wide and diverse audience is a simple and valuable service you can do for your institution. And please invite your faculty to use MBR articles in their classes. Unlike other journals, which charge for classroom use, MBR will always make its articles freely available for use in degree program classes.

We are confident that, like us, you will find MBR to be an exciting new tool which we can all use individually to better do our jobs and collectively to transform the world. We are delighted to have you join us in getting the most out of this innovative new publication.

Antonio Bernardo,
Anderson School of Management,
UCLA, USA

Frank Chen,
City University of Hong Kong, China

Murray M. Dalziel,
Merrick School of Business,
University of Baltimore, USA

Robert M. Dammon,
Tepper School of Business,
Carnegie Mellon University, USA

Scott DeRue,
Ross School of Business, University of Michigan, USA

Kevin F. Hallock,
Cornell SC Johnson College of Business, Cornell University, USA

Dipak Jain,
China Europe International Business School, China

M. Eric Johnson,
Owen Graduate School of Management, Vanderbilt University, USA

Ilian Mihov,
INSEAD, France

Li Mingjun,
China Europe International Business School, China

Matthew J. Slaughter,
The Tuck School of Business, Dartmouth College, USA

Rajendra Srivastava,
Indian School of Business, India
“Humanocracy makes the case for replacing chain of command with chain of trust and radical transparency. It’s a prescription for unlocking game-changing innovation and the value of every individual.”

— Marc Benioff, founder, chairman, and co-CEO, Salesforce; New York Times bestselling author, Trailblazer

In their new book, Gary Hamel and Michele Zanini make a passionate, data-driven argument for tearing up the bureaucratic playbook. Drawing on more than a decade of research and packed with examples, Humanocracy lays out a detailed blueprint for building organizations that maximize contribution, not compliance. The goal: resilient organizations, great jobs, and zero bureaucracy.
What is capitalism? Is it the greatest source of prosperity and freedom the world has ever seen or a menace on the verge of destroying the planet and our society? Rebecca Henderson argues that capitalism is the only solution to the massive problems that we face and explores the ways in which the private sector can help to reimagine capitalism so that it works for everyone.

Capitalism is one of the great inventions of the human race: an unparalleled engine of prosperity, innovation, and individual freedom that has lifted billions of people out of poverty. In 1910, 1.75 billion people lived in extreme poverty—now, though the world’s population has more than tripled, only about 0.7 billion do. In the 1950s half of the population lived on less than $2 a day. Now it’s only 13 percent. In 1820, 43 percent of the global population died before the age of five. Only 4 percent do now.

But in many places inequality has climbed to levels not seen since the 1920s. In the US and the UK those at the bottom of the income distribution have not had a significant pay raise in the last twenty years. Social mobility has fallen dramatically: the odds that children born today will make more than their parents is now less than fifty percent. Across the world, minority populations continue to be largely excluded from the economic mainstream. In the US, for example, the average median household income for Hispanic people is 70 percent that of whites, while for Black people it is less than 50 percent.

At the same time, the planet is warming. Left unchecked, global warming threatens to destabilize the climate, squeeze the world’s food supply, flood many of the great coastal cities and force millions of people to migrate. One million of the world’s eight million species are faced with extinction, while the burning of fossil fuels continues to cause enormous...
damage to human health every year. Emissions have fallen (slightly) in the face of the COVID-19 pandemic but they are poised to bounce back hard and fast.

We have allowed our societies to get radically out of balance.

What happened?
The problems we face have many causes, but one of them is that we have allowed our societies to get radically out of balance. In the 1970s and 80s, economic development was guided largely by the Washington Consensus, a view that focused overwhelmingly on the power of free markets to drive growth. Because of the Consensus, influential bodies such as the World Bank and the IMF pushed developing countries to embrace far-reaching deregulation and privatization, and to open their domestic markets to global trade and free capital flows as routes to development, without explicit attention to the health of local political or social institutions. Beginning in the 1990s, however, this strategy was increasingly challenged on both empirical and theoretical grounds.

Many states that adhered to the Consensus failed to do as well as expected. In post-Soviet Russia in particular, the rapid liberalization of markets was followed by a descent into crony capitalism. Meanwhile, the so-called “Asian tigers”—especially Taiwan, Singapore, and South Korea—succeeded economically by pairing market development with heavy government intervention.

It became increasingly clear that the rule of law, well-designed corporate governance, anti-corruption safeguards, democratic government, a free media, and appropriate financial regulations are critical to enabling free markets to stimulate high quality development. Scholars came to distinguish between “inclusive” and “extractive” societies. Extractive regimes concentrate both political and economic power in the hands of an elite few. Healthy inclusive societies, by contrast, rest on three foundations: a free market; a strong civil society; and a democratically elected, transparent, capable, and responsive government. Together these three institutions hold each other accountable, balancing the power of the free market with the need to provide public goods and the need to ensure that the market remains both free and fair.

In the US, in the 60s and 70s, this balance was broadly understood. Businesses saw themselves as partners in generating prosperity that benefited everyone. But by the early 80s, managers in much of the developed world had begun to believe that their sole responsibility was to increase profits, even if that meant dumping greenhouse gases into the atmosphere, driving wages so low that employees were forced to depend on government support, and lobbying for rules and regulations that favored only themselves.

This belief in profits alone arose from a transformation in economic thinking pioneered by Milton Friedman and his colleagues at the University of Chicago following World War II. While many of their arguments were highly technical, the intuition behind them is straightforward. They first suggested that the efficiency of free markets makes them a spectacular driver of economic prosperity. In truly competitive markets booming demand triggers the kind of innovation and entrepreneurship that produced smartphones and Airbnb, while competition forces down their prices. Second, Friedman and his colleagues argued that by opening up economic opportunity to anyone, regardless of family, color, or creed, free markets allow people to control their own destiny, building political power. In their view building a functioning democracy in a state that controls how you work for and how much you’re paid is difficult, if not impossible. Third, the Chicago economists held that managers work for their investors and not for themselves. Since investors generally want to make as much money as possible, managers who did anything other than maximize returns were therefore indulging themselves at their investors’ expense and betraying their investors’ trust.

Collectively, these arguments implied that doing anything other than maximizing profits — to charge less than the market will bear for a lifesaving drug, for example, — was not only to abandon your duties as your investors’ agent but also to make society poorer and less free.

Initially, this approach appeared to be a way of organizing society...
that delivered all that it promised. In Asia, Eastern Europe and South America, for example, many nations that adopted free market thinking saw explosive economic growth and increased political freedom. China’s embrace of free markets brought more than a billion people out of poverty. Successful managers and entrepreneurs like Bill Gates, Steve Jobs, and Mark Zuckerberg became cultural heroes.

It became increasingly clear that markets require adult supervision.

But as the economy flourished, the world around it did not. It became increasingly clear that markets require adult supervision. Markets only lead to prosperity and freedom when they are genuinely free and fair. Intuitively, if firms can dump toxic waste into rivers, lie to their consumers, and form alliances to fix prices, there is no guarantee that maximizing profits will increase either aggregate wealth or individual freedom.

It’s also important to remember that Friedman and his colleagues first formulated their ideas in the aftermath of the Second World War. At the time, there appeared to be a serious risk that a reliance on the market would be replaced by centralized planning. Government – after conquering depression and war – was popular and powerful. Capitalism, in contrast, was not. In the developed world at least, the state could be relied upon to ensure that markets were reasonably competitive, that externalities such as pollution were appropriately priced or regulated, and that (nearly) everyone had the necessary skills to participate in the market. Moreover the experience of fighting the war had created immense social cohesion. Investing in education and health, “doing the decent thing,” and celebrating democracy seemed natural. Under these conditions, it was not unreasonable to believe that “unleashing” the market by telling managers their only job was to increase shareholder returns would, in turn, maximize both economic growth and individual freedom.

But in the last seventy years the world has changed almost beyond recognition. Institutions that have historically constrained the market are under attack across the board. In many countries people no longer feel a sense of common identity. Instead we are increasingly divided by racial, ethnic or religious loyalties and by basic worldviews. Governments everywhere are increasingly unable, or unwilling, to focus on the long term or on the well-being of the entire community. In the developed world, politics is increasingly deadlocked, fragmented, and angry. Meanwhile many governments in the developing world are corrupt. And although our problems are global, we have few effective global institutions.

Left unchecked, markets are subject to powerful incentives to destroy the natural and social worlds around them.

In short, global capitalism looks less and less like the textbook model of free and fair markets enabled and controlled by civil society and democratic government on which the injunction to focus solely on profit maximization was based. It’s not surprising, then, that we are increasingly neither prosperous nor free. The U.S remains the richest nation on the planet, but the income and wealth of most of the population hasn’t increased in over twenty years. At the same time, we are destabilizing the climate and poisoning the sea.

Our fixation on maximizing shareholder value is actively making things worse. As long as the private sector’s untrammelled pursuit of profit at any cost took place within strong, well governed societies, it created enormous value. But left unchecked, markets are subject to powerful incentives to destroy the natural and social worlds around them.

As a result, the responsibilities of firms have changed dramatically. The deepest moral commitments of capitalism require that they help to sustain the health of the institutions on which the free market relies. If firms exist to maximize prosperity and social welfare, they have a moral duty to act as if there were a price for carbon, for example, even when there is no price in place. If firms exist to maximize freedom of opportunity, they have a responsibility to invest in health care and education, or to persuade the government to do so. The first step towards reimagining capitalism is thus not to abandon shareholder value but rather to embrace the idea that firms also have a duty to support the health of the natural, social, and institutional systems on which capitalism relies.

What can be done?

Without rebuilding our governments and our societies, we will not solve the problems we face. We need to mobilize people around the world in a massive political and cultural movement that demands that we stop heating the planet and destroying the ecosystems we depend upon, that insists on the widespread provision of education and health care, a genuine voice for labor, real racial inclusion, and the kind of redistributive taxation that would ameliorate the worst effects of inequality.

But business also has a central role in building a just and more sustainable world. Governments
are national, while our problems are global. Politicians tend to focus on the short term, while we need to focus on the long. Waiting for governments to act is ever more clearly a recipe for disaster. Business is arguably the most powerful institution on the planet. Only firms can drive the innovation we need at a scale that can solve today’s environmental problems and generate the jobs upon which decent lives are built.

Business has a compelling economic reason for solving the big problems.

The good news is that business has a compelling economic reason for solving the big problems. It will be much easier to make money in a world in which the climate is relatively stable, in which the coasts are not underwater and in which agricultural collapse is not routinely triggering the migration of hostile, hungry populations. Moreover the private sector benefits from a world with significantly less poverty and inequality. Societies that have reduced inequality and poverty have generally increased access to education and capital and, through some combination of minimum wage laws, lowered entry barriers, and organized labor representation, maintained relatively high wages while using tax revenues to ensure that no one is left too far behind.

Throughout history, many firms have opposed these kinds of measures. The East India Company was a legally entrenched monopolist and fought tooth and nail to maintain its position, corrupting English politics for nearly a hundred years. Very few firms have actively campaigned for higher taxes, stronger unions, or increased social spending. But there is overwhelming evidence that the private sector as a whole is much better off in more open and more equal societies.

Countries governed by corrupt oligarchs can grow very fast and within them, individual companies can do very well. In Nigeria, for example, between 2006 and 2015, an extractive government that catered to oil interests (and received massive kickbacks from their operations) saw its GDP grow at an average of 7.6 percent per year. Likewise Turkmenistan, which harshly repressed religious and political freedom, grew at 11 percent. In a weak economy, small reforms can unleash significant potential, but growth under crony regimes is highly unstable and often stalls once the economy approaches the global production possibility frontier. Genuinely open markets, well established property rights, and a free media provide a much stronger foundation for new entrants and for the kind of creative destruction that generates substantial value. Widespread access to education and health care accelerates this virtuous circle by creating deep pools of talent and strong domestic demand. In states with inclusive institutions, GDP per capita has historically been much higher than in states with extractive institutions, and the gap has broadened over time.

The economic case for solving big problems is therefore reasonably straightforward. It is nonetheless a collective case and operates at the most basic level. It may therefore seem unlikely that any but the most visionary and confident business leaders would attempt to act on it. So what are some practical ways in which the private sector can respond to these incentives and, in so doing, both make a difference and meet their responsibilities to their investors? Could these actions in turn add up to real change?

Walmart saved about $1bn a year by redesigning its trucking fleet to reduce energy use.

It seems likely that the current move towards shared value, or towards the simultaneous creation of private profit and public benefit, is a critical first step. The evidence that there are broad opportunities to create shared value is extensive. Walmart saved about $1bn a year by redesigning its trucking fleet to reduce energy use. An alternative meat company recently became the most successful $200m+ IPO of the last twenty years. And Tesla is well on its way to becoming the world’s most valuable automobile company. Firms that adopt high road employment strategies, which create jobs that pay well, treat employees with dignity and respect, grant them significant discretion to shape their own work, and build a collective sense of purpose, have repeatedly found that the strategy creates significant economic value.

Although such actions are sometimes derided as greenwashing or dismissed as too small or local to have any real impact, they often drive broader change. In the first place, they act as demonstration projects: proving that a private business can solve a public problem, driving the technology along the learning curve, demonstrating that new business models are feasible, and helping to develop a network that new entrants can use. Solar and wind power have both become multi-billion-dollar businesses and, in many parts of the world, renewable energy is now cheaper than conventional fossil fuels. Although we still face significant barriers to decarbonizing the world’s energy system, it now appears that it can be done at reasonable cost, given the right regulatory environment. Ten years
Many fisheries could be almost completely regenerated within a couple of years.

In principle, an industry in such a position can both increase its profits and generate significant social benefits by choosing to self-regulate. Many fisheries can be almost completely restored if they are given a couple of years to recover. Fisherpeople who can jointly agree to restrain themselves in the short term will usually find themselves much better off in the long term than those who cannot. Indeed, right now, nearly half the world’s fisheries are governed by some form of self-regulatory arrangement. Cooperative arrangements to tackle the twin problems of sustainability and unacceptable labor practices have also emerged in cocoa, palm oil, beef, timber, and soy, while similar agreements are underway in the textile and IT industries and in mining and minerals.

In some cases, these voluntary self-regulatory arrangements have been extremely successful. The International Chamber of Commerce, for example, is an entirely voluntary body that regulates the world’s trade, while cooperative arrangements significantly reduced deforestation in the Brazilian Amazon for many years. But these efforts are often unstable. Without any real penalty for failing to cooperate, firms are often tempted to renege on their commitments and revert to business as usual.

A very large fraction of the world's financial assets are controlled by roughly twelve firms.

Who—or what—might be capable of enforcing cooperation between firms, essentially forcing them all to do the right thing and leaving no one at a competitive disadvantage if they do? There are two possibilities. The first is investors. A very large fraction of the world’s financial assets are controlled by roughly twelve firms. These firms are so large that they cannot diversify away from the threat of catastrophic risks such as climate change. Some of the world’s wealthiest owners are similarly exposed. The Japanese government pension fund, for example, is worth more than $1.6 trillion and owns roughly 1 percent of the world’s equity markets. Hiro Mizuno, who was its chief investment officer until early 2020, came to believe that solving problems like social inclusion and climate change was central to his fiduciary duty because they posed severe risks to his long-term returns.

The emergence of ESG metrics (Environmental, Social, and Governance) could give investors the means to insist that firms tackle environmental and social problems, and to track their performance as they do. More and more, investors are working together to push the firms they own to address both social and environmental risks. For example, more than 450 investors, representing $40 trillion in assets, have banded together to form Climate Action 100+, a group devoted to pushing the world’s 100 largest emitters to set concrete targets for reducing carbon emissions and transitioning to a carbon free economy.

The second institution that might force firms to do the right thing is, of course, government. If governments worldwide regulated or priced carbon emissions, for example, it would be in every firm’s economic interest to solve climate change. If governments strengthened labor regulations, making it illegal to pay any worker less than a living wage, if they invested heavily in education and health, actively supported employee organization and aggressively taxed the wealthy, inequality would fall. If it were illegal for corporations to flood the political system with money and if anti-trust regulations were routinely enforced, the largest and most powerful firms would be much less able to shape the rules of the game in their own favor.

Could it happen?

Could business actually help to rebuild our institutions? Businesspeople are already coming
together to lobby in favor of carbon regulation and against money in politics. We Are Still In, for example, brings more than 2,000 firms together with NGOs, faith communities, and city and state governments to lobby for pollution reduction targets which will allow the US to comply with the Paris climate agreement. In cities across America, local firms are working with civil society and city governments to improve the health of their communities.

In the current environment it may be difficult to imagine the business community lobbying for a wholesale rebuilding of the institutions of an inclusive society, but it has happened before. In the English Civil War of 1642-1649 and the Glorious Revolution of 1688-1689, a substantial middle and upper class bourgeoisie worked to usher in democratic reforms. More recently Germany’s private sector played an important role in developing Germany’s current institutions, working collaboratively with organized labor to develop a system of apprenticeship training that is often cited as one of the central determinants of the country’s low inequality and high productivity. And an expanding body of research suggests that in South America the private sector has sometimes played a positive role in supporting democratic transitions, while the struggle to dismantle apartheid was strengthened by British commercial concerns about the system.

Could it happen again? Could the private sector play a central role in rebuilding our democracies? Should it? It might seem an unlikely idea. But ask yourself – what is the alternative? If business stays silent, focused on profit alone, what will happen? The COVID-19 pandemic has given us a profound opportunity to rethink our society and our institutions. We must seize the chance to reimagine capitalism. ■

**For Further Reading**

If you enjoyed this article you might enjoy Professor Henderson’s recently released book: Reimagining Capitalism in a World on Fire published by Hachette/Public Affairs, 2020

---

**Rebecca Henderson**

is one of Harvard’s twenty-five University Professors. She is a research fellow at the National Bureau of Economic Research, and a fellow of both the British Academy and of the American Academy of Arts and Sciences. She is an expert on innovation and organizational change. Her most recent book is “Reimagining Capitalism in a World on Fire” (Hachette/Public Affairs, April 2020). She was named one of three Outstanding Directors of 2019 by the Financial Times.
WHEN YOU REACH THE TOP, THERE'S ONLY ONE THING LEFT TO DO ... KEEP RISING

THE ART OF EXCELLENCE™

We've long had aviation down to a science. You inspire us to reach higher. Every day, we spark innovation, apply passion and perfect details. We advance aviation to an art form.
How do companies translate their strategy into operational actions that support it? Strategists use a different language than operational workers, and often the statements of the CEO have little connection with what the employees do. Christoph Loch, Stylianos Kavadias, and B. C. Yang suggest a tool that can help companies to align their employees’ actions with strategies, clearly explain that alignment, and encourage innovation from the bottom up and collaboration between departments, all in a way that can be completely customized to the company’s strategy.
1. The Difficulty of Cascading Strategy
Translating strategy into action is hard. Many organizations have found themselves in circumstances in which the CEO has developed a sophisticated strategy but, because no one has taken the time to convert big strategy statements into specific targets and plans, the employees end up doing things that do not support that strategy. Likewise, some companies realize too late that they have a strategy and operational plans, but that the two are not aligned. Let us take the example of CCC, a mid-sized European consumer credit company. Exhibit 1 shows its structure at the time of our involvement, which consisted of two business units: an established business partnership with a large retail chain under the partner’s brand and a newer unit designed to help CCC grow a credit business under its own brand. Each unit and the respective support functions had been asked by the CEO to develop their individual strategies in the context of the overall strategy.

Both units had ambitious growth plans, though with slightly different emphases. The new business would be based on branding a broad assortment of credit services and providing excellent customer service. The established supplier would enhance the value of its partner through technology, compliance, and collaboration. The strategic plans of the support functions, in the spirit of best practices, emphasized functional excellence, so that the heads and directors could feel certain about their unit’s performance, but none explicitly described or supported the business objectives. Unsurprisingly, given this approach to strategy execution, the company was unable to make decisive progress toward its business goals. Many companies find themselves similarly deadlocked when their various functions are not aligned.

There are four fundamental reasons why companies frequently fail to effectively execute intelligent strategies:
1. Weak top-down alignment: Goals are poorly, if at all, articulated or they are inconsistent and fail to contribute to the whole. A typical

---

**Exhibit 1:** The business and functional strategies of CCC

<table>
<thead>
<tr>
<th>Support Functions</th>
<th>Own Brand</th>
<th>Retail Partner Brand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strategy: Build brand identity and awareness with a combined card/loan/insurance offering and superior customer experience</td>
<td>Strategy: Drive retail partner’s growth by increased penetration through technology, compliance, and customer experience</td>
</tr>
<tr>
<td>Sales</td>
<td>Best in class sales capability through service culture and reduced churn</td>
<td></td>
</tr>
<tr>
<td>Funding</td>
<td>Local and diversified funding strategy</td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>Best in class analytics capability</td>
<td></td>
</tr>
<tr>
<td>IT</td>
<td>Become a leader in security, system stability, and technology</td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>Become an employer of choice, strengthen and retain key skills</td>
<td></td>
</tr>
<tr>
<td>Compliance</td>
<td>Build compliance infrastructure on par with leading banks</td>
<td></td>
</tr>
<tr>
<td>Risk</td>
<td>Best in class risk team to secure business models and growth</td>
<td></td>
</tr>
</tbody>
</table>
indication of this problem is the use of generic targets drawn from industry benchmarking, which generally do not support the organization’s specific priorities. The overarching message must be translated into useful and mutually consistent functional, regional, and project objectives.

2. Weak bottom-up innovation or modification: Strategy is often treated as an optimization effort, with its planning being rigidly divided from execution. The reality is more fluid: implementing strategy requires creative insights, tracking mercurial market demands, technology opportunities, and competition. The necessary adaptability cannot be achieved solely by analysts at the top. It requires all the information available to an organization, including from frontline personnel, suppliers, and partners. Companies must have a way of incorporating new observations and ideas into their strategy and its articulation.

3. Limited collaboration: Too often each unit in an organization adopts its own targets and then pursues them in isolation, as though overall strategic priorities could be achieved by simply putting the separate work of disparate units in a heap. But organizations are messy and complex, particularly in the tasks where units interact to deliver outcomes. A classic example from the 1980s describes a parts logistics manager who cuts inventories to save costs, thus hurting the service manager who wants to increase customer satisfaction by having parts available to customers at short notice. Unit managers must negotiate their targets and their interrelationships with one another. They must collaborate in responding to uncertainty and share their ideas for better approaches.

4. The limited strength of quantitative planning: The uncertainty and complexity of organizations often renders purely quantitative targets insufficient – the numbers are too coarse, difficult to obtain, and inflexible to compromise. They require complementary qualitative agreements that colleagues can discuss at regular strategic reviews.

2. Tools and Processes

The cascading tree represents a multidirectional (top-down, bottom-up, and horizontal) communication process. Many companies try to ensure better strategy execution by using scorecard tools, such as the balanced scorecard (BSC) and the Hoshin Kanri planning processes. In strategy cascading, however, the greatest challenge is that everything, from decisions about coordination and priorities to management and multi-level discussions, is specific to the particular organization. Nonetheless, in successful companies, managers make sure these discussions reflect a systematic dialogue: from the top down, from the bottom up, and horizontally between colleagues, teams, and business units. We have observed several such dialogues which suggest a way, rooted in total quality management, to devise an effective process of cascading strategy discussions. Exhibit 1 describes the principles by which high-level goals may be translated into operational goals that can be tracked through a simplified (educational) example. Let us suppose that we have set a strategic goal, perhaps shedding those extra kilos. How do we ensure that this lofty mission is successfully put into operation? Let’s trace the steps on the graphic below.

The first step in our cascading effort is to realize that, unless we set a tangible target, we will never achieve change because, without clear evidence that we are making progress, we will tend to allow the mission to be overshadowed by other urgent things. So, it is essential to set a target. Let us suppose that our target is to get below 80 kg (for some of us, this may be a very ambitious target).

The second step is to identify and articulate the actions we’ll need to take to achieve this target. At the highest organizational level, these actions will be more general and comprehensive than at the operational levels: eat less (calories in) and exercise more (calories out). Makes sense. But these goals are too far removed from the stresses of our day-to-day life, in which we need to monitor whether or not we have acted in pursuit of the mission every day. It is therefore necessary to translate these actions further downward.

The third step is to treat high(er)-level actions as “missions” for the next step down, and start over again. So we set a specific target for each action – eat fewer than 2,000 kcal and burn more than 2,500 kcal per day (again, this is brutally ambitious!) – and develop actions (no chocolate and more veggies, and jogging) that are closer to making the plan operational, but still do not determine specific actions that can be credibly monitored every day. To get there, we move to a third iteration which dictates actions such as “put veggies on my plate at every meal” (appealing to our impulse to politely empty our plate), and “put the running gear in the way so I stumble over it” which leaves us no excuse to back out. By selecting actions that we can monitor every day, we make our everyday activities support our strategy.

The green arrows represent three important features that an effective cascading process should
Given that top management is responsible for achieving the strategic mission, it certainly needs a top-down element. But who knows what the best actions are? In the graphic, perhaps swimming or aerobics is better suited to our capabilities than jogging, and the people with operational roles know it. Bottom-up input is therefore crucial in choosing the activities best suited to ensuring that we execute the strategy successfully. Novel ideas from the operational levels may even suggest ways to improve the strategy. Everyone should therefore have a clear explanation of the strategy and be given the means to articulate their own ideas (and pursue the best ones). Top-down and bottom-up communication is crucial.

Finally, none of the actions are independent. No one operates in an isolated silo, so it is naïve to put too much faith in the notion that if everyone just does what they are supposed to, we will all be fine. The tough no-chocolate-plus-veggies diet, for example, may make it harder to maintain the motivation to jog. Perhaps one square of low-calorie dark chocolate after each run could act as an incentive to keep jogging. The goals of different departments interact and mutual communication and negotiation are required in order to design goals that will add up to more than their sum (rather than less when they get in each other’s way). The cascading tree really represents a multidirectional (top-down, bottom-up, and horizontal) communication process:

1. Top management articulates (high-level) goals.
2. The next level articulates first-level actions (“this is how we can do this”) and negotiates interdependencies between departments: “I need you to support me by doing ‘x’ so that I can achieve my bit” or “don’t do ‘y’ because it will hinder me.” Keeping track of these high level (and often important) interdependencies regulates the give
and take between departments, keeping everyone honest and making it harder for anyone to get a free ride.

3. Departments check their actions by submitting reports to the next level down. Are there better ideas? Are there additional interactions?

4. Next, the contributing parties should negotiate how to meet their goals: Can we achieve the goals (or perhaps with a different mix even exceed them)? Top management can choose to take a hard line, or it can be open to change, perhaps in response to the organization’s ambition and innovation.

5. The people in those groups that are directly affected by a higher-level goal (for example, the “less chocolate” and “more veggie” groups in Exhibit 2) should, at this level, discuss the goals together. This conversation will allow them to understand what everyone does, to discuss conflicts, and to discover how, through give and take, they can be more productive together while also holding one another accountable. They are also likely to uncover and negotiate a number of small interdependencies. Although it might be possible to ignore some of these, talking them over renders the resulting plan of action more robust, and makes the participants better colleagues, since they have already grappled with conflicts and found recipes for working through them.²

6. Make this level’s actions the missions for the next level down, and then start again from step 2. The cascading tree is constructed recursively downward, with feedback rising back up. After 3 or 4 iterations, though, further levels become unwieldy and consistency harder to maintain. Through this process, a portfolio of operational activities emerges, with specific priorities and known interdependencies. Sometimes the overall goals may shift levels, or even dimensions. Moreover a hierarchical goal tree is morphing into a vertical and horizontal series of discussions in which everybody works together to develop organizational performance, everyone is fully informed and understands the operational imperatives, and new ideas emerge and are put to good use. If everyone in the organization trusts that those who offer more will build credit rather than being exploited or reprimanded, the end goal often becomes more ambitious than what was originally proposed.

This cascading process is consistent with four principles which we have identified through our research. These principles are vital to allowing a company to effectively cascade a multi-dimensional strategy.

1. Strategy cascading requires formal quantitative targets, just as proposed in the BSC. Without them, it is difficult to act. However, the targets must not be generic, using benchmarks based on other organizations. They must instead be custom-built from the strategy and priorities of their own organization. The straightforward principle of measuring what you want to achieve, not what others do, is still often ignored, whether for convenience or from a lack of confidence in our own goals.

2. Strategy cascading also requires qualitative process targets (commitments to do things). Most strategies are multi-dimensional and cannot be fully captured by one set of targets, particularly when some of the targets are hard to quantify in simple KPIs (key performance indicators). One example is Sinyi’s ethical principles, which we will discuss at greater length below. A cascading tree may contain both quantitative and qualitative targets, including training and socialization, as well as high-level cultural encouragement of less rigidly structured achievements that support the company’s principles.

3. Ideas which travel upward from the lower levels are fundamental to this multi-dimensional strategy. Even simple strategies involving, for example, cost performance need bottom-up input to take full advantage of the organization’s wealth of knowledge. This knowledge may spring from sales and marketing in regard to customers, from operations and supply chain management in regard to delivery performance, from accounting in regard to economies, and so forth. This principle is even more important to multidimensional strategies, in which only frontline and middle management understand the subtle interplay of myriad employees’ individual behavior. Successfully cascading a multi-dimensional strategy goes hand-in-hand with adapting that strategy to innovations, most of which rise from below.³ Incorporating these ideas also respects fair process – giving everyone a voice – which motivates people emotionally to contribute rather than resist.

4. All three of these principles are underpinned by two organizational capabilities: effective communication and top management behavior. A strategy is not just a conceptual position statement; it is a battle plan that, if all employees understand and internalize it, produces alignment. It is therefore vital to explain the strategy to employees, not once, but continuously over time. It is also essential to open information channels through which they can express ideas and offer feedback. And while strategy cascading is a process (a defined sequence of actions), it cannot be programmed. The whole structure depends on the behavior of the people at the
top. If they do no more than pay lip service without actually listening to ideas and feedback, the strength of any cascading process will wither. On the other hand, if senior managers participate sincerely, the transparency which cascading creates will help to control their bias in favor of their own ideas.\(^4\)

This process does not usually proceed as a set of theoretical questions such as: What are we trying to achieve?, What do we need to do?, or Who will be assigned the tasks? Instead it is rooted in what is actually there. The discussion moves from strategic imperatives to contributions from the existing organizational units, often passing through several iterations if the initial proposals don’t achieve their aims. This process has two pragmatic implications: first, the resulting cascade is not the only answer; driven by their different processes, capabilities, and cultures, different organizations may come up with very different ways to achieve similar things. Strategy articulation and execution are creative exercises, not the mindless application of an algorithm (indeed, there is no algorithm). Second, the question is not whether the assignment of [theoretical] tasks is complete, but whether every unit has stepped up. In some cases, a particular unit may simply not have anything to contribute to a particular goal, but anyone who does not participate sufficiently should bear the consequences.

Let us consider a simple example of cascading strategy from this perspective. This example is based on a project that we undertook with the police department of a city. The department had set the goal of significantly reducing violent crime, especially robberies of residential houses in all vulnerable precincts. The police wanted to know how to start working toward this goal without simply writing checks to add more officers. Exhibit 3 summarizes the cascading process that we developed together.

In a workshop with three hierarchical levels, the police officers first described their target – not eliminating crime entirely, but reducing it by 20 percent (which seemed possible with a feasible resource commitment). They then identified two dimensions of action as being the most promising: increasing patrols by street officers, and educating residents about how they could help minimize the occurrence of robberies. These actions were then assigned specific targets (one patrol per day, one home visit per month). The home visit target could be put into action by one branch of the police (community counselors), while the patrol target would be addressed by frontline officers. After the necessary training and preparation, both groups began to act.

In translating the patrol target into everyday actions, officers from different departments discovered that they could share patrols; although traffic cops and municipal street cops were already patrolling, they were working separately, uncoordinated. By sharing the tasks of both groups and developing priority schedules that took both traffic and vulnerable periods into account, the effective number of patrols could be increased without increasing budgets or manpower. However,

---

**Exhibit 3**: Cascading process in a municipal police department

**Mission**: Reduce serious crime (e.g., domestic robberies)

20% reduction

<table>
<thead>
<tr>
<th>Target action</th>
<th>Target action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase patrols at hot spots</td>
<td>Communicate with people when they leave their homes</td>
</tr>
<tr>
<td>One additional patrol per residential sector</td>
<td>One visit per month for houses in hot spots</td>
</tr>
<tr>
<td>Merge different types of patrols</td>
<td>Distribute leaflets in houses</td>
</tr>
<tr>
<td>Set rush hour times for patrols</td>
<td>Conduct orientation sessions</td>
</tr>
</tbody>
</table>
to achieve this cooperation, both sides had to invest in the training and in each other’s patrol targets (How many traffic violations went undetected? How many houses were unobserved?). These compromises required negotiations between the two units, which had never collaborated in this way before. The resulting operating procedures took time and effort, demanding that the unit heads and their senior teams build a constructive relationship. It took over a year to achieve, but the end result was effective because they had come to have a shared vision and the confidence to communicate effectively with each other and with their superiors.

What mattered during this process was not the derivation of an optimal set of KPIs, but the increase in communication and guidance which taught the two branches to collaborate. Only through this communication and learning were they able to change their behavior so that the strategy could be carried out. KPIs alone would have led to more isolated behavior, following the letter but not the spirit of their goals and failing to understand the effects of their behavior on colleagues.

3. Comparison with Other Cascading Tools
There are certainly other cascading tools already in wide use. Four of the best known are: the balanced score card (BSC) proposed by Kaplan and Norton in 1983,\(^{5}\) the Hoshin Kanri Planning process that Toyota and a few other Japanese companies began to develop in 1950,\(^{6}\) the Objectives and Key Results (OKR) application invented by Andy Grove at Intel in the 1980s,\(^{7}\) and the strategy briefing process proposed by Bungay (2011).\(^{8}\) The strengths and weaknesses of these methods are laid out in Table 1.

<table>
<thead>
<tr>
<th>Table 1: Overview of some widely used cascading methods</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Balanced Score Card (BSC)</strong> (Kaplan and Norton 1983)</td>
</tr>
<tr>
<td><strong>Logic</strong></td>
</tr>
<tr>
<td><strong>Strengths</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Limitations</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

A cascading tree offers an intelligent compromise – an explicit guide to constructive top-down, bottom-up, and cross-unit negotiation processes that build common understanding and alliance – emphasizing a collaborative process.

All tools have limitations. The BSC has often been used as a generic indicator (rather than articulating unique qualities) and has a top-down flavor that does not bring out the best in employees. Hoshin Kanri is perhaps the closest method to what we propose, but it is most effective within operations (already two levels down in our cascading tree). When an organization starts the process with a high-level strategy, the Hoshin matrix becomes extremely complex and process-heavy. OKR focuses on individual goals for change, yet, while acknowledging the benefits of transparency, it does not address interdependency or collaborative problem-solving. The strategy briefing process focuses on articulating strategic trade-offs and priorities at the top level, and on the goals and actions of senior executives, without connecting to the front line. Our cascading tree offers an intelligent compromise – an explicit guide to constructive top-down, bottom-up, and cross-unit negotiation processes that build common understanding and alliance – emphasizing a collaborative process. Managers have to work for it, but it enables true strategic customization, without becoming a heavy-handed bureaucratic process.

### 4. Case Example: Sinyi Realtors

There is ever increasing pressure on companies to serve multidimensional constituencies and goals, for their private shareholders, financial markets, regulators, customers, and society. The traditional simplicity of maximizing shareholder value has come under attack, in the wake of the 2008 financial crisis, as being insufficient. Moreover, in an age in which society increasingly expects companies to consider the environment, employee benefits, and societal contributions, firms must devise multifaceted strategies that embrace the deep conflicts between multiple goals. How can these complex demands be translated into operational targets?

Let us look at one company that has made ethical business its core principle, the Taiwanese real estate broker Sinyi Co. Sinyi was founded in 1981 in Taipei by Chun-Chi Chou and has, since the turn of the century, become the largest and most respected real estate brokerage in Taiwan. It has a 15 percent market share, revenues of US$190m, profits of US$27m, and, as of 2016, 3,000 employees. Initially, Mr Chou found real estate to be a scattered industry in which the practice referred to as “earning the price spread” was common – if the final purchase price was higher than the seller’s original minimum price, the agency would appropriate the difference along with the (legal) commission. One of the first principles that Mr Chou introduced was that his firm would not use this unethical method. Instead, Sinyi would offer the customer total transparency. The company expanded this first practice over time into a range of service innovations, all aimed at serving the customer in an ethically clean and transparent way. This philosophy was eventually formalized in the company’s mission:

Our purpose is to foster secure, speedy, and reasonable realty transactions through the synergy of expertise and teamwork, providing Sinyi’s employees with a secure working environment in which to grow while generating reasonable profits to sustain the group’s survival and development.

This mission statement sets several goals, balancing the benefits to Sinyi’s stakeholders: customers, employees, shareholders, society, and the environment. Sinyi is a for-profit organization, but it does not pursue profits to the exclusion of everything else. Having begun with the principled decision to forgo price-spread arbitrage it went on, without direct compensation, to introduce additional customer benefits over the years, such as offering customers full coverage for any disagreeable surprises in their new property. Sinyi also leads the way in reporting its environmental footprint and contributes generously to civic projects in its communities.

**Top-Down Cascading**

Strategy cascading in a company such as Sinyi has a business component but is also rooted in collaboration and common beliefs, without which the multiple stakeholder core of its ethical principles would not operate in a balanced way. As a result, (even our simplified representation of) Sinyi’s cascade strategy requires at least two cascading trees. The first concerns revenue, garnered through a differentiated strategy of providing customer service and earning customer trust. This position cascades into operational targets and processes in a standard quantified way, as shown for two levels in Exhibit 4.

While the exhibit shows the tree for the sales target (revenues and market share), the numerical values are omitted for reasons of confidentiality. The higher level reflects strategic priorities: employees must buy into and live the premise that customer trust and ethical behavior translate into business. Sinyi doesn’t just sell houses; it sells...
service. Providing high quality service is therefore a high-level action and its processes, such as consistency and speed, must support sales. Each high-level action has a target: all employees must fulfill the trust value; quality of service is formally tested by various measures of customer satisfaction administered not by anyone in sales, but by a separate quality department; and customer interactions and conversions per branch and per month are subject to an assortment of efficiency measures.

The second level actions support the first level targets, embodying the overall strategy. The left column shows that Sinyi prioritizes employee training, both formally and through cultural immersion. The center column supports client satisfaction, emphasizing the helpful and problem-solving nature of the individual realtor’s work. Transparency, including openness about price range or other bidders, is built into the process. This column also describes additional services such as guarantees and case-by-case add-ons reflecting the needs or desires of individual customers. The right column supports this work by laying out standard operating procedures (SOPs) which structure the salesperson’s work as well as the accompanying legal functions, and which ensure that the team collaborates and shares information. (The legal department has a separate set of process goals which have allowed it to reduce turnaround time by a third over the last five years.)

These formal business goals do not fully capture the ethical principle of sharing benefits with stakeholders. The sales goals are founded on the assumption that being ethical builds trust and good business, but stakeholder ethics also comprise a goal in their own right. So they also need to be connected to operational activities throughout the company. The second cascading tree, in Exhibit 5, delineates these connections.

The firm’s target is to continue to clearly differentiate itself as the most ethical player in the industry. This target is not aligned with the sales target but intersects with it. Combining both in one tree would result in confusion rather than transparency, so the company instead created two trees (pretty much the upper limit of complexity that a cascading tree will support). The ethics target is supported by four high-level goals: investments that explicitly acknowledge the needs of all stakeholders; ethical employee behavior (in accordance with company norms); a chief ethics officer, installed in 2010, who embodies employee centeredness and ethics; and the establishment of specific incentives. Each goal has a target, from “make all projects follow our principles” to “incentivize ethical behavior throughout.”
As in Exhibit 4, we see a strong emphasis on HR practices, not only on training but also on the selection of new employees according to their interest in others and their ability to be considerate and collaborative.

The chief ethics officer (third action) acts both as the conscience of the organization, informally encouraging employees to abide by its ethical principles, and as a catalyst for innovation. These roles necessitate a close relationship between the CEO and the chief ethics officer. For example, the chief ethics officer gives a short presentation at every meeting of the TEM, reminding attendees that the ethical principles of the business are a priority. The chief ethics officer also resolves dilemmas and conflicts within the organization. When two salespeople disagreed about sharing the commission for a large sale they had both worked on, the chief ethics officer reminded them of the Sinyi principle that taking advantage of others is a sin. He advised the more senior salesperson to concede the larger share of the commission to the more junior because senior staff have a responsibility to help and educate junior staff.

Sinyi has a similar policy for incentive structures, making commissions smaller relative to salaries. A Sinyi commission is about 12 percent of the company’s fee (compared to 20-30 percent elsewhere), of which one-third goes to the team. This practice encourages teamwork and ethical, customer-oriented service to a greater degree than those of competitors. Violations of the company’s customer service policies, for personal profit or any other reason, result in immediate punishments including public shaming and fines (though the shaming is considered more severe). Meanwhile, teamwork and voluntary engagement in community activities are encouraged and informally rewarded.

We succeed not in isolation, but through collaboration amid interdependency.

Horizontal Communication
Sinyi’s practices ensure that all its employees understand and represent the company’s values. In our interviews at Sinyi, we found that workers at all levels demonstrated a clear understanding of what makes Sinyi unique. As their chief ethics officer puts it,
“people must believe that this positioning can breed success.” Sinyi’s employees also expressed confidence that, when necessary, their ideas will be heard by top management. The cascading processes at Sinyi are not cold and mechanical; they embody the values of the owner, the CEO, and the senior team. As a result, some of the cascaded goals affect the entire organization, revealing its broader interdependence. The initial six-month training, for example, certainly covers effective selling (“It taught me how to speak to people,” said one salesperson), but it also encompasses collaboration, empathy, and taking care of each other as ends unto themselves, not just as business goals. By encouraging salespeople to engage in their communities, the company finds business opportunities and also adds value to those communities without directly measuring the value of community contacts converted into customers. These actions, laid out across several cascading trees, acknowledge that we do not succeed in isolation, but through interdependency.

And Sinyi has a range of goals which would never work without interdependency or without each member of the organization sharing a common understanding of the company’s mission and values. Various HR practices guide the selection and training of employees so that they learn, in their first year with the company, the importance of this balance and how to achieve it. In the words of Sinyi’s chief ethics officer, “We tell our people that they embody the values of the own organization and willingly go the extra mile.

Nonetheless, front-line salespeople who can change their processes feel a sense of ownership – they know they have a voice and influence which causes them to identify with the organization and willingly go the extra mile.

Salespeople can also initiate formal changes to the company’s process. For example, the current stock of houses for sale used to be visited weekly, every Friday. But the sales staff found that this schedule was sometimes too slow to allow them to effectively compete for desirable properties, so salespeople are now allowed to visit a new house any time, once it has come up for sale. They discuss ideas like this in the daily morning meeting, a practice very much in the spirit of continuous improvement in total quality management. Because of their direct input, the salespeople feel that, although it is formally owned by the customer service department, they also own the SOP, and that it reflects their knowledge and shared best practices. Of course, not all proposals are accepted: one salesperson experimented with thoroughly cleaning a house for the buyer in hopes of triggering a decision, but the company rejected making cleaning part of the SOP because it would have been economically burdensome. Nonetheless, front-line salespeople

**Bottom-Up Innovation**

The goals we have discussed come largely from a vision of the business which comes down from the top. For twenty years Sinyi’s competitors have striven to usurp its position by adopting similar language and promising customers the same integrity. Although none have yet matched Sinyi’s consistency in customer service, the company has to evolve constantly to stay ahead. Sinyi has therefore consistently innovated new services over the last twenty years.

Such guided innovation is ideal for nurturing projects that address weaknesses (e.g., process improvements in response to customer feedback) and for taking advantage of strategic opportunities (such as a new management information system that improves workers’ knowledge of their customers, sales records, and process integration). The TEM agrees upon these projects before handing them over to the strategy office and the customer service department.

However, employees at all levels are encouraged to initiate activities and influence goals, driving innovation and change from the bottom as well as from the boardroom. Salespeople have a budget with which to test new customer service ideas. One salesperson, learning that her client did not like to reuse slippers others had already used, bought some disposable slippers before a house visit. Her experiment was so successful that it was formalized as a standard option.

Front-line employees are encouraged to send messages with ideas for change to both the CEO and the chief ethics officer. These officers read and responded to each message, and a few result in recommendations or follow-up projects. Store and regional managers are asked to bring innovation ideas to the TEM for discussion. And Sinyi continues to steadily improve its operating performance, introducing roughly one major new service per year, including a takeback guarantee covering problems that are discovered after purchase, and an investigative service to determine whether anyone has ever died in the house (an important issue in Chinese culture).
who can change their processes feel a sense of ownership – they know they have a voice and influence which causes them to identify with the organization and willingly go the extra mile.

In flexible and innovative companies, strategic goals change and evolve with the information that arises through the bottom-up initiatives.

5. Strategy Execution as a Process
Finally, the proposed cascading system can help organizations to adapt. Management scholars agree that there is a need for adaptable strategies which respond to the fundamental uncertainty of the world around us. The time has passed when strategy was a static set of detailed goals, planned and optimized. Yet managers still know too little about how to set up and support adjustments of strategy in response to changes in the environment. One clearly demonstrated path to successful adaptation is the process we have described in this article.

Exhibit 6 illustrates that adaptive strategy execution is a cauldron of ideas and decisions which circulate in all directions. At the top, there are broad goals responding, with the help of formal analysis and decision tools, to the societal, technological, and market environment. These goals need to be translated into high-level operational targets (in this case “improvement and productivity” and “new products and innovation”). The top-down arrow, then, corresponds to our high-level cascaded goals. We have found that top management teams have the capacity to pursue and supervise perhaps fifteen to twenty strategic change projects on top of their usual responsibilities. Most of these changes are compatible and can be pursued within the existing structures and processes. For these, cascading asks each unit, “What can you do to make this happen?” Few strategic projects cannot be accomplished within the existing structures. These few may require an additional unit with different experts, equipment, or perhaps entrepreneurial approaches. And for these, the cascading needs to start from scratch, just as it would for any major project which assigns people to new tasks not already being performed by incumbents.

In all the strategic changes which are compatible with existing

---

**Exhibit 6: Strategy cascading as a creative process**

- **Business Strategy Goals** (e.g., growth, market share, profit)
  - Top-Down Cascading
    - Improvement and productivity
    - New products and innovation
  - Formally planning
    - Portfolio or SWOT analysis
    - Market intelligence, technology monitoring
  - Horizontal Collaboration
    - Formal and informal networks
    - Visits and conferences
    - Shared processes, collaborative projects
    - Culture and openness and exchange
  - Functional bottom-up information/ideation schemes
    - Customer feedback
    - External contacts (such as trade fairs, suppliers, universities, benchmarking with other companies)
    - Suggestions
    - Improvement projects (such as Kaizen, 6σ), innovation slack (such as quality circles, experimentation budgets), suggestion system

---
structures, information also flows up from the bottom, carrying not only many small improvements but also higher-impact ideas. These are collected through various mechanisms and drive the generation of innovative initiatives in the middle. For example, the company where we first saw the cascading tree in action changed its operations strategy from “cost leadership” to “time leadership” when front-line personnel suggested that, by speeding up processes, customer service could be transformed into a competitive weapon and, because speeding up would require operations to be eliminated, costs would also decrease. There are some well-known examples of similar strategy changes. In the 1980s Intel was transformed from a memory chip manufacturer into the market leader in processor chips after a bottom-up revolution in which middle management eventually persuaded their seniors. Likewise, in the 1990s, the ideas of middle management, which the upper levels took a decade to accept, reorganized IBM into a service business, converting hardware production units into internal suppliers. Bottom-up ideas don’t just drive improvements on existing goals, they also introduce new performance elements (new services, new customers, new ways of defining value) that surpass existing strategic goals and help the company to innovate.

All of the arrows (which represent information and communication flows) should be supported by institutional mechanisms and processes, as well as cultural norms that encourage employees to contribute. Alignment, compatibility, and mutual creativity should be expected to be negotiated between units, divisions, and teams, again supported by a combination of mechanisms including processes and cultural routines and habits. These institutional processes are not necessarily to be found in process handbooks, but are both formal or informal actions that are widely accepted and recurring. Formal actions might include sanctioned and resourced six-sigma (continuous improvement) projects, benchmarked across several units, while informal actions could be talking to external contacts or discussing best ideas and the interactions between them with colleagues.

This system of top-down, bottom-up, and horizontal cascading orients employees toward shared goals and emerging changes in the environment, as well as promoting horizontal transparency and alignment. We call this situation a cauldron because, to an outsider it may look like a chaotic stew of seemingly unconnected activities. But the outsider does not see the combination of processes and cultural rules that aligns the system with shared goals. The cauldron does require patience and persistence, but as one Sinyi senior manager put it: “Gaining everyone’s trust is very difficult and a never-ending journey, and it is constantly subject to undermining and misuse, by customers and sometimes employees. Our results indicate that the public honors our efforts, and our reputation is unparalleled. This represents no laurels on which we can rest, but an encouragement to keep moving forward.” And strategies rarely create a monopoly on which an organization can rest securely. Instead, strategy offers a foundation from which to keep trying. Even Sinyi’s service portfolio has changed dramatically over the last twenty years, yet the underlying values (of sharing with customers, employees, and society) remain.

No tool is universal, no matter how you stretch it. As an organization grows, even the cascading tree reaches its limit. Sinyi uses horizontal collaboration targets, rather than KPIs, to strengthen employee alignment with its overarching goals. But as a company expands and the numbers in its hierarchy increase, people at the lower levels become irresistibly tempted to focus on their local KPIs and the grander purpose begins to recede. Another organization we worked with grew from approximately 10,000 people to nearly 20,000 (six times larger than Sinyi). This organization opted to reduce specifically local KPIs (however well designed) and to emphasize higher-level KPIs. The change helped people to recognize the bigger picture and understand that they were all in the same boat, encouraging dynamic negotiations about actions that might not improve an individual’s success but would help wider groups to achieve larger goals. To keep such a large organization on track, strategy alignment must be loosened, or the levels of detail in the cascading tree limited.

In flexible and innovative companies, strategic goals change and evolve with the information that arises though the bottom-up initiatives. There is no precise recipe for how strategy cascading and execution should look. Their organizational content depends on economics, markets, and culture along with myriad smaller factors. Nonetheless, despite the case-to-case details, certain core elements exist in any cascading system that strategically aligns and executes adaptation. Excellent cascading allows an organization to change its strategies without having to manage a crisis.
Appendix: A Brief Overview of Academic Work on Strategy Cascading

For a long time, both academics and practitioner professionals have wrestled with the problem of strategic alignment of organizational actions. They have approached it in four ways, none of which addressed it systematically. Resource allocation theorists approached strategy execution on the notion that action occurs wherever the money goes. Strategy execution can certainly be quite formal, sometimes involving metrics, but it can also be driven by culture. Execution has likewise been approached as a decision between several possible resource allocations, using capital budgeting methods, or through the more qualitative lens of strategic program portfolios. But in order to allocate resources effectively, companies must combine considerations of strategic action portfolios, financial circumstances, and company culture.

Agency theorists observed that the firm’s objective might not be that of the employee (agent), and suggested that compensation and incentives might be important to aligning strategies. A famous paper foreshadowed the dangers of untargeted incentives, demonstrating the fallacy of “rewarding A while hoping for B.”

Other scholars approached strategic alignment as a problem of communication and coordination. They argued that, while rewards and metrics cannot be viewed independently from strategy and structure, the firm must decide what to communicate to its employees as strategy, and then use what has been communicated to drive reward systems. The clarity with which a strategy is explained to organizational units is thus a key enabler. Moreover, both vertical alignment and horizontal communication and collaboration are then required to achieve alignment. This view is consistent with our cascading tree proposal.

Finally, analytical hierarchical planning (AHP) strove to formalize the link between strategic goals and the complex execution decisions required at different levels of the hierarchy. While offering interesting insights into the methodology of deconstructing complex decisions into smaller and simpler choices, AHP has been criticized for its restrictive formalism and for trying to automate a process that relies upon subjective evaluations and perspectives.

Table 1 examined four important cascading tools that are currently in wide use. Other scholars have emphasized the importance of alignment, the need for employees to understand, and identify with, the overarching goals, so that their actions will strengthen the company’s strategic position. Managerial recommendations tend to echo the concerns raised in the theoretical literature that aligned measures must be subject to modification from the bottom-up in response to changes and new ideas. Our cascading tree proposal fulfills these needs. There is also a long-standing discussion of the measures that influence behavior. For example, FAST (frequently discussed, ambitious, specific, and transparent) measures have supplanted the previously popular SMART (specific, measurable, achievable, realistic, and time-bound) model. While this discussion is certainly important, it does not directly address the problem of alignment. Indeed, as we have described, some companies have chosen to reduce the specificity and direct consequences of performance measures in order to achieve collaboration throughout the company and support the (fuzzier) whole.

Christoph Loch is a Professor of Technology and Operations Management and Dean of the University of Cambridge’s Judge Business School. For thirty years, he has worked with organizations of various types on executing innovation, managing complex and uncertain projects, and emotionally motivating professional employees.

Stylianos Kavadias is the Margret Thatcher Professor of Technology and Operations Management and Director of the Entrepreneurship Centre at the University of Cambridge’s Judge Business School. He is an expert in product development and innovation, and on the entrepreneurial journey of new ventures.

Yang Bai-Chuan (B.C.) is an Associate Professor of Business Administration and a member of the board of trustees at Fu Jen Catholic University in Taipei. He serves as Chief Ethics Officer and adjunct Chief HR Officer at Sinyi Realty Group. He is dedicated to advancing the application of ethics theory in business practice.
Endnotes

1. We observed this for the first time many years ago when it was used by a successful leader, Dr. Jessen, at Festo.


3. This has been shown in Kim, Y. H., Sting, F. J., Loch, C. H. 2014. Top-down, bottom-up, or both? Toward an integrative perspective on operations strategy formation. Journal of Operations Management, 32(7–8), 462–474.


Whatever the Challenge, Be WHARTON READY.

Programs for Executives
LIVE VIRTUAL LEARNING EXPERIENCES

When the only constant is change, your strongest advantage is Wharton. Be ready for greater success with the proven strategies and in-depth business acumen you can only get from our world-class faculty. Choose from a wide portfolio of results-focused programs now delivered in a live virtual format.

FIND YOUR PROGRAM ›
exced.wharton.upenn.edu/READY

UPCOMING PROGRAMS:

NEW Distressed Asset Investing and Corporate Restructuring
OCT. 20–30, 2020 • LIVE VIRTUAL

Customer Analytics for Growth
OCT. 26–30, 2020 • LIVE VIRTUAL

Scaling Ventures: Developing the Playbook for Profitable Growth
OCT. 26–30, 2020 • LIVE VIRTUAL

NEW Designing and Managing Supply Chains for the Future
NOV. 2–6, 2020 • LIVE VIRTUAL

General Management Program
FLEXIBLE LEARNING JOURNEY
Alumni status granted upon program completion
What Is Organization? The Evolving Answer

Dave Ulrich
Ross School of Business, University of Michigan and The RBL Group

Consider how much the organizations where you live, work, and play affect your life! In this short article, Dave Ulrich reviews the evolution of organizational logic, helping each of us to better appreciate our organizations and help them to deliver value.
Organizations shape nearly every aspect of our lives: work, health, learning, social, and spiritual. They turn personal beliefs into value created for others, individual aspirations into shared agendas, private thoughts into collective outcomes, and discrete actions into sustained patterns. Disneyland’s value of being the “happiest place on earth,” for example, creates value for my wife and me when, as guests, we see our granddaughters chortle with delight at meeting Cinderella. They turn with joyful eyes and say with glee, “Grandpa, she’s real . . . and she’s beautiful. Thank you!” Our happiness is instantly multiplied by delighting them. And so the Disney organization’s values create sustainable value for their guests (customers).

Research confirms the impact of organizations on personal experiences. In researching Victory Through Organization, my colleagues and I collected data from 1,200 organizational units and 32,000 individuals. We found that organization (culture, capability, workplace, process) has four times the impact of individual (talent, competence, workforce, people) on business results. Likewise, at the Academy Awards, about 20 percent of individuals who win best actor or actress are in the movie that wins best picture. In basketball, soccer, and other team sports, the team with the top scorer wins the championship about 20 percent of the time. Individuals may be champions, but teams win championships.

What Does an Organization Look Like?
While organizations have long mattered and will continue to do so, the way we answer the question, “What is organization?” has evolved. Understanding this evolution will help leaders to create the right organization, employees to manage their careers, customers to partner with their suppliers, and investors to evaluate the organization.

Figure 1 provides an overview of the evolution of organizational thinking. For decades, if asked to draw an organization, respondents would produce some version of hierarchy that looked like a pyramid. This logic provided stability, career mobility, and process improvements. Leaders clarified authority by defining roles, improved processes with reengineering, and determined career paths through specialization.

Next, organizational logic pivoted toward a systems approach in which different organizational processes (strategy, structure, rewards, people) were aligned to deliver results. Using this logic, leaders made sure that organizational processes enabled their strategies and interacted to deliver their products.

This organizational thinking then morphed into a capability logic in which the organization is not viewed as a structure or system, but as a collection of capabilities: what an organization is known for and
good at doing which define its identity.\(^3\) Leaders in this organizational logic are responsible for diagnosing and delivering those capabilities, like innovation, agility, customer service, information, or efficiency, to their customers. Disney’s capability of delighting guests is thus the essence of its organization.

Recently, the organization species has evolved once again, and in a flurry of potential names (network, holocracy, amoeba, ambidextrous, boundaryless). Arthur Yeung and I synthesized many of these options\(^4\) and coined the term **market-oriented ecosystem (MOE).** Instead of being organized into divisions to which a chain of command allocates resources, the MOE has a platform of resources (money, people, technology) that is dedicated to market opportunities. Leaders of the MOE assign an independent team (or cell) of employees to each market opportunity. These cells then anticipate customers’ requirements and quickly respond to them.

**Moving Ahead**

Understanding how the answer to the question, “What is organization?” has evolved will help leaders to prevent their organization from becoming the next Blockbuster, Sears, or Nokia, failing to adapt to shifting market conditions. Employees with a contemporary organizational logic can design their careers to match their organization’s requirements. Customers can partner with evolving organizations to fulfill their individual needs. Investors can discover and invest in the organizational intangibles which create sustained value.

Organizations affect nearly every area of our lives. Knowing what organization is today allows all stakeholders to make better, more informed choices about getting the best out of their organizations.

---

**Endnotes**

1. See the work of Alfred Chandler, Max Weber, or Mike Hammer.
2. See STAR model by Jay Galbraith, 7-s or organization health by McKinsey.

---

Dave Ulrich is the Renssis Likert Professor in the Ross School of Business at the University of Michigan and a founding partner of the RBL Group. He has written over thirty books and hundreds of articles on organization, leadership, talent, and human resources. He has earned numerous awards and recognitions and presents widely on these topics. dou@umich.edu
**Make Smarter Decisions**

_Give Yourself a Nudge_ shows you how to make smart decisions guided by your values, and teaches practical decision-making skills that give you the ultimate advantage in business and life: smarter decisions.

“Decision-making really is a learnable skill and Ralph Keeney is a master teacher with compelling examples, exercises, concepts, and steps to share.”

_– Daniel Goroff, Vice President and Program Director, Alfred P. Sloan Foundation_

“Read this book to build your wealth or bolster your health. Using practical advice wrapped in accessible language, distinguished decision-making expert Ralph Keeney explains how to identify and analyze critical decisions in your life, how to enrich your set of alternative choices, and how to value possible outcomes. It is precisely what you need to foster better choices in your professional or personal life.”

_– Richard Zeckhauser, Frank P. Ramsey Professor of Political Economy, Harvard University_

You can purchase this book at your local book store, Amazon, and Cambridge University Press. For bulk sales, contact https://www.cambridge.org/us/academic/specialsales/
The consensus in social psychology is that monetary incentives for performance have a detrimental impact on individual performance. Yes, under certain specific and limited conditions, rewards can reduce performance. Yet pay for performance schemes are ubiquitous. How can we resolve this divergence between theoretical recommendations and observed practices? Nirmalya Kumar and Madan Pillutla recommend solving the problem by designing smarter incentives that avoid these detrimental effects.
In his classic 1993 *Harvard Business Review* article, Alfie Kohn argued:

“Certainly, the vast majority of U.S. corporations use some sort of program intended to motivate employees by tying compensation to one index of performance or another. But more striking is the rarely examined belief that people will do a better job if they have been promised some sort of incentive. This assumption and the practices associated with it are pervasive, but a growing collection of evidence supports an opposing view.”

Citing a body of psychological research, Kohn reasoned that incentives which rely on increasing extrinsic motivation unfortunately lead to lower intrinsic motivation and are therefore doomed to fail. He ended his article by concluding “bribes in the workplace simply can’t work.”

Over the years, Alfie Kohn’s perspective has been reiterated by others, most recently by Daniel Pink. With over 25 million views, Pink’s TED Talk, “The Puzzle of Motivation” is among the ten most popular TED Talks of all time. Based on experiments conducted by psychologists over the past two decades, Pink concludes that, except when applied to the simplest tasks, monetary incentives, or what he calls “if, then rewards” fail to improve performance. This view reflects the current consensus in the social psychology literature. As Pfeffer observes: “literally hundreds of studies and scores of systematic reviews on incentive studies consistently document the ineffectiveness of external rewards.”

Other scholars acknowledge that rewards may work, but only for those with low incomes. This view argues that, above a certain earning level, offering people incentives in the form of bonuses and higher pay is ineffective because it does not increase their happiness. Yet despite the prevalence of these views, pay for performance, in the form of bonuses, rewards, and incentives, is still ubiquitous in organizations. Even the CEOs of global companies and private equity managers receive a substantial portion of their earnings in the form of compensation for producing specific results. Making variable pay an integral and vital component of the design of wage systems is generally considered best practice. How, then, can we reconcile the deleterious effects of incentives documented in academic research with their popularity in practice? We have drawn upon our review of a considerable body of academic literature over the past two decades to demonstrate that the negative effects of pay for performance have been exaggerated. Monetary incentives can and have been shown to have negative effects, but these arise only under specific conditions which, for the most part, are not common in organizations.

The introduction, or use, of pay for performance schemes thus results in a different (more motivated, more productive) pool of employees, self-selecting themselves into an organization.

Before we examine the academic research that documents these two detrimental effects of pay for performance, it is important to note a general factor which limits most laboratory social psychology studies on this subject. While working in a laboratory does enhance internal validity by randomly assigning subjects to treatment or control conditions, it ignores the beneficial sorting effect which incentives have on performance. Lazear, for example, reported that the increase in the productivity of a company that switched from salaries to individual incentives was produced in equal parts by existing workers increasing their productivity (incentive effect) and by less productive workers quitting and being replaced by more

---

**Monetary incentives can, and have been shown to, have negative effects, but these arise only under specific conditions which, for the most part, are not common in organizations.**
productive ones (sorting effect).\textsuperscript{2} The introduction, or use, of pay for performance schemes thus results in a different (more motivated, more productive) pool of employees, self-selecting themselves into an organization. Because we have here concerned ourselves only with the incentive effects and ignored the sorting effects, the detrimental influence of pay for performance in the many studies mentioned below is actually overstated when applied to practice.

**Increased motivation leads to lower performance**

Sometimes, the increased motivation to succeed which is inspired by higher incentives can have a detrimental effect on performance. Often referred to as “choking under pressure,” some workers have been found to respond to incentives by performing worse than expected, given their skill and historical performance. Scholars offer two explanations for the paradoxical negative effects of this over-motivation.

**Distraction**

Proponents of distraction theory argue that the pressure induced by potential rewards fills our minds with irrelevant thoughts about the situation and the importance of earning the rewards. Our concerns about performance and the effects of earning or failing to earn the rewards compete for our attention, which was once focused solely on the task at hand.

A typical study of distraction theory asked participants to solve two types of math problems, with or without a monetary incentive.\textsuperscript{3} Subjects were given a series of novel math problems that either required the use of working memory or that were heavily practiced and could therefore be retrieved from long term memory.\textsuperscript{4} One set of subjects was given no incentive while the other was offered five dollars for solving the problems. Researchers found that the monetary incentive led to a deterioration in performance on working memory problems but not on long term memory ones. These results, as well as those from other studies, suggest that, because high incentives draw attention away from the task, jobs that require extensive use of working memory will tend to be the ones negatively affected by the offer of monetary rewards.

Almost all the empirical evidence in support of distraction theory is laboratory based. These studies have in common the use of discrete performance events with no opportunity to prepare differently after the incentives are announced. The findings can therefore be applied to organizational settings only to a limited extent.

While they might apply to relatively brief and clearly defined tasks (e.g., making an advertising pitch or a sales call to an important client), even here large incentives might
cause the worker to prepare better, overcoming any potential distraction. Offering someone a million dollars to do well immediately prior to an advertising pitch might have unfavorable effects, but offering that same million three months prior would probably induce the worker to devote the intervening months to preparation and would therefore lead to better performance. And this latter scenario is far more characteristic of organizations.

**Overthinking**

Scholars of explicit monitoring theories propose that the pressure of high incentives increases anxiety and self-consciousness which, in turn, drive people to pay more attention to specific skill processes. Workers try harder to exert conscious control over the specific steps of what they need to accomplish in the hope that being scrupulously careful will increase their chances of success. However, researchers believe that attention to performance at such a minute level actually disrupts the automatic processes that would otherwise not require working memory.

The most commonly cited evidence for the detrimental effects of explicit monitoring is drawn from empirical studies conducted in the sports arena. For example, psychologist Rob Gray offered accomplished players high or low incentives to bat in a baseball simulator.\(^5\) Batters in the high reward group were told, after they had completed a first set of trials, that they and a randomly assigned partner would each receive twenty dollars if they increased their performance by 15 percent in the next round. They were then told that the partner had already achieved the increase and that it was up to them to ensure that they both earned their reward. Batters in the low reward group were not promised anything. Researchers found an increase in batting errors and movement variability among the high reward group.

What is more interesting, though, is that the high reward group’s batting failure was accompanied by improved judgment (as assessed through verbal statements made during batting) about the direction in which they were moving the bat.

Further research suggests that it is not the incentives per se that cause the overthinking which undermines performance, instead it is the accompanying pressure to monitor and report, referred to in the literature as procedural accountability. So the procedural accountability which often accompanies higher rewards is what drives overthinking, which does lead to more accurate judgment, but unfortunately also disrupts routine skills.

**One simple way to reduce the detrimental impact of rewards on experts, then, would be to separate large performance-based rewards from procedural accountability.**

One simple way to reduce the detrimental impact of rewards on experts, then, would be to separate large performance-based rewards from procedural accountability.

**Higher incentives reduce motivation to perform**

The explanation given more frequently by those who argue against paying for performance is that incentives ironically lower motivation to perform. In this scenario, the offer of rewards emphasizes the person’s monetary motivation, crowding out what academics consider to be “good motivations.” Two types of good motivation have been extensively researched in the context of the negative effects of incentives. For the most part, economists have focused on how incentives reduce workers’ motivation by undermining their sense of nobility. Meanwhile, social psychologists have concentrated on the detriment to intrinsic motivation.

**Undermining nobility**

People engage in a great many tasks because they see them as part of their duty or because they feel it demonstrates goodness of heart.
organization. Paying people specifically for these actions tends to cheapen the good deed because it undermines how the activity is viewed, either by the actor or by her peers. People will thus perform the activity less in the face of monetary incentives.

**Signalling**

People improve their reputations by performing good acts such as donating blood or volunteering for community projects. Their motivation to do good appears to depend upon the degree of personal sacrifice required. This sacrifice can be viewed as the act’s opportunity cost—the cost, to the individual, of other opportunities for personal benefit which they have given up in order to undertake this activity.

Perhaps the most recognized example of how incentives undermine noble motives is Titmuss’ comparison of blood donation in the UK and US. His central finding was that, in the UK, where donors are not paid, both the quality and quantity of blood for transfusion were higher than in the US, where donors were paid. While it is not surprising that paying for blood drives down the quality, since it gives people an incentive to lie about whether they are sick, it is remarkable that the quantity per capita also goes down. Although Titmuss’ work has drawn considerable criticism over the years, primarily over the quality of his data, the idea that paying people for something they would have given willingly might undermine their motivation to give has survived the test of time. And Titmuss’ blood donation case is one of the examples used by Nobel laureate Jean Tirole in his threshold model for prosocial behavior.

Signalling nobility of character is a very important aspect of the threshold model. If the opportunity cost of noble behavior is too little, or is seen by others as too little, the individual’s motivation to perform the activity decreases correspondingly. For an activity to feel really worthwhile, people need to feel (and show) that they have incurred a significant cost. On the other hand, if the cost is too much, people will lose motivation. So there is a specific threshold at which people will perform a noble act; if the cost falls below or above a certain amount they will be less likely to participate. Paying for performance, then, may lower the opportunity costs to below the threshold and remove the opportunity to signal sacrifice, bringing about lower performance.

Recent research using large-scale field experiments shows that offering lottery tickets, gift cards, or noncash incentives such as T-shirts has a neutral or positive effect on the number of blood donors, particularly those who donate infrequently. Studies in domains other than blood donation support the conclusion that non-monetary incentives such as a ‘star performer’ award do not undermine participation the way monetary awards do and can actually increase noble behaviour. The motivating effect of these incentives is increased by making them public (as through award ceremonies).

However, the research that documents the undermining effects of monetary incentives is usually conducted with participants for whom the noble or pro-social task is not their main occupation. Non-financial rewards may be more effective in these cases because participants’ financial needs are being met elsewhere. We would therefore not expect financial reward to have the same undermining effect on people whose main job is the performance of these noble actions (like those employed in the charitable sector). For these individuals, pay for performance might still increase their performance of the noble behavior.

**Transformation of frame**

Paying for the performance of a task can transform an activity from a non-market based communal exchange (like helping out a colleague who is having trouble with a task or assuming their responsibilities when they are ill) to a market transaction. It puts a price on doing a previously voluntary activity, transforming how people view it. Faced with an incentive, people start to evaluate whether it is worth engaging in the activity for the amount in question.

To demonstrate this phenomenon, the economists Gneezy and Rustichini conducted an experiment using ten day care centers. They randomly chose six of the centers and introduced a small fine for parents who were more than ten minutes late to pick up their children. In day cares where the fine was introduced, parents immediately started arriving late, with tardiness eventually leveling out at about twice the pre-fine rate. Introducing a fine actually caused twice as many parents to be late! Tardiness was unchanged in the four day care centers with no fines. The fine had transformed how parents felt about their obligation towards the day care center workers. Instead of viewing it as their duty to pick up children on time and let the workers go home, parents now felt that their decision to arrive on time was an economic one in which they could pay for the privilege of being late.

The danger of undermining the sense of nobility is of interest to organizations because it suggests that managers should be careful with how they offer incentives for the many behaviours they expect from workers outside their core job. While firms may wish to reward those who take on more of these organizational citizenship behaviours, they should
avoid making that reward too transactional. A yearly 360-degree evaluation of helpfulness will probably produce better results than paying employees for each individual act. The latter method may lead them to start putting a price on each act, and then evaluating whether that price is worth their effort. Publicly

By making the rewards a product of peer nomination, Google converts a cash payment into a symbol of appreciation. As a result, people are less likely to see the reward as cheapening their noble behavior.

By making the rewards a product of peer nomination, Google converts a cash payment into a symbol of appreciation. As a result, people are less likely to see the reward as cheapening their noble behavior.

giving people gifts or other non-cash awards is another way to avoid this pitfall.

Google appears to have discovered a way to pay people for being helpful without making it transactional. The company invites employees to nominate colleagues who have been helpful to receive small cash rewards. By making the rewards a product of peer nomination, Google converts a cash payment into a symbol of appreciation. As a result, people are less likely to see the reward as cheapening their noble behavior.

Undermining intrinsic motivation
The most frequent argument against pay for performance, though, is actually not one of those we have presented above. Instead, the primary point of Kohn’s paper and the consensus among social psychologists, is that it promotes extrinsic motivation and reduces intrinsic motivation. Emphasizing incentives causes people to feel a loss of autonomy. In the face of the extrinsic motivation of an incentive system people tend to lose their mastery orientation, the intrinsic motivation that drives the individual’s search for excellence.

To understand this effect, and how organizations can guard against it, it is important to understand the difference between extrinsic and intrinsic motivation. Extrinsic motivation refers to behavior that is driven by external rewards such as money, fame, grades, and praise. Intrinsic motivation stems from an internal drive which allows intrinsically motivated individuals to experience personal enjoyment or satisfaction while performing certain activities. The activity provides its own inherent reward, so motivation for these activities is not dependent on external rewards.

The evidence for the undermining of intrinsic motivation
The evidence for how pay for performance can undermine intrinsic motivation is rooted in a body of literature led by Deci & Ryan. These studies found that tangible rewards, especially monetary ones, tend to undermine participants’ intrinsic motivation. There are usually three phases to an experiment of this kind. In the first, subjects are given an interesting task (often a puzzle) and asked to work on it without payment. The experimenter then leaves the room and monitors whether and for how long they continue to work. This observation measures intrinsic motivation. In the second phase, participants are offered a payment to do a similar task. In the third and final phase, they are again asked to work on the interesting task without payment. Researchers found that, when not directly observed, participants engage less with the interesting task in the third phase than in the first phase. Scholars view this waning interest as indicative of a decrease in intrinsic motivation because the reward has been withdrawn. However, as the reader can likely surmise, despite the common conclusion that these studies constitute evidence of the detrimental effects of pay for performance, the broad inferences drawn from them are problematic. The undermining effect of rewards could be purely transitory. People may have a natural level of engagement in the task which is based on their intrinsic motivation. When the rewards increase their engagement, this level is exceeded such that when the reward is withdrawn, their engagement may be temporarily reduced while they recover from the excess engagement. In this case, they will revert back to normal in the long run. Furthermore, the undermining effect has been traced primarily with regard to interesting tasks, which might not constitute the majority of jobs in an organization.

Using incentives without undermining intrinsic motivation
According to social psychologists, in order to understand the undermining effects of rewards, we must consider how the recipients are likely to interpret them. Specifically, the effects of a reward depend on how it affects the recipient’s perceptions of autonomy and competence. When monetary incentives interfere with an individual’s sense of autonomy or competence,
they tend to decrease intrinsic motivation.

Different kinds of incentives influence our sense of autonomy and competence in different ways and therefore have different effects on intrinsic motivation. In general terms, we can sort rewards into two types.

**Task contingent rewards** are those that are given simply for engaging in or completing a task (e.g., a salesperson filling out sales call reports). Since the recipient is required to work on or complete the task in order to receive these rewards, they could be perceived as controlling. This sense thwarts the worker’s need for autonomy while providing minimal information about their competence. Because the loss of autonomy is accompanied by no corresponding increase in feelings of competence or mastery, task contingent rewards can reduce intrinsic motivation.

However, these negative effects do not make task contingent rewards inherently unsuitable for organizations. Organizations are rife with uninteresting and repetitive tasks in which a known process exists to create a desired outcome (e.g., production lines). These tasks carry little intrinsic motivation in any case, so the detrimental effects of incentives are less relevant. The extrinsic motivation engendered by incentives should help employees to engage more intensively with such an activity than they would otherwise.

**Performance contingent rewards**, by contrast, are those which are earned by performing a task well (e.g., a commission on sales or a profit linked bonus). These rewards certainly increase extrinsic motivation, but it is vital to ensure that the increase does not come at the cost of intrinsic motivation. Because most managerial performance in organizations requires teamwork, creativity, solving novel problems, learning, and judgment, for all of which intrinsic motivation is crucial, any pay for performance system that undermines intrinsic motivation is inherently counterproductive. The wise solution in this context is carefully designed performance contingent rewards that enhance feelings of competence and do not undermine autonomy.

Performance contingent rewards which reinforce a sense of competence can help offset any undermining of autonomy. Likewise, if the person delivering the rewards has an appropriate interpersonal style, she can help to reduce the feeling that autonomy is being lost. From these principles we have devised five recommendations about designing and delivering performance-based rewards without undermining intrinsic motivation.

---

**Make sure that monetary incentives are accompanied by positive feedback and encouragement so that they don’t lead to a sense of lost autonomy.**

1. Make sure that monetary incentives are accompanied by positive feedback and encouragement so that they don’t lead to a sense of lost autonomy. Using a coercive interpersonal style, for example making threats, will be seen as controlling and will therefore undermine intrinsic motivation. Offer performance-based incentives only for achievements beyond the minimum standard required for continued employment. Workers should be able to decide whether they want to earn a bonus without worrying about being fired. This freedom ensures that they do not feel a loss of autonomy.

2. Incentives which depend on undefined performance standards or achievements which clearly rely on luck do not offer any feedback about the recipient’s competence and therefore do not compensate for any perceived loss of autonomy. Incentives should be based on specific standards which employees can understand and achieve through effort and skill.

3. Incentives which are accompanied by information about the recipient’s performance relative to others will increase their sense of competence and correspondingly increase their intrinsic motivation.

4. Do not offer performance-based incentives for trivial accomplishments which have little to do with competence.

---

**Conclusion**

Designing compensation systems is a complex but critical skill in running an effective organization. We have not attempted to cover the entire landscape of compensation, but rather to debunk the common belief that performance incentives have a negative effect. This broad, overarching conclusion which some authors have drawn is based on relatively narrow and specific studies. To make the blanket statement that “bribes in the workplace simply can’t work” or “if-then rewards never improve performance” is just not true.

We acknowledge that under specific conditions offering incentives can cause employees to choke because they are distracted or overthinking. And, in certain limited situations, rewards can reduce performance by removing the sense of nobility or undermining intrinsic motivation. However, as Table 1 shows, thoughtful intervention can reduce or prevent these detrimental effects in organizational contexts. In short, not only is pay for performance...
an essential component in an effective manager’s toolkit, but by adopting these recommendations managers can learn to design smarter incentives.

Nirmalya Kumar is the Lee Kong Chian Professor of Marketing at Singapore Management University and a Distinguished Academic Fellow at INSEAD Emerging Markets Institute. As well as nine books and nine articles in Harvard Business Review, he has also published in the Academy of Management Journal, the Journal of Marketing, and the Journal of Marketing Research.

Madan Pillutla is a Professor of Organizational Behavior at the London Business School. In his research he uses social-psychological perspectives to understand organizational behaviors. His recent papers include an examination of the interplay between bias and self-interest in selection decisions (JPSP, 2018) and of the mobility of individuals of low socioeconomic status within organizations (Academy of Management Annals, 2019).

Endnotes


4. Theorists see long term memory as the enduring stock of knowledge and skills, while working memory is limited to the very small proportion that is actively in use at any given time.


Seizing the Moment: Having Difficult Conversations about Race in the Workplace

Conversations about race in the workplace have long been silenced. Recently, though, leaders have begun to fervently embrace such conversations. Drawing upon academic research, Stephanie Creary provides a framework for having difficult conversations about race in US workplaces.
In US workplaces, society, and around the world, calls for racial equity, justice, and inclusion have become ever more common and forceful. Countless companies have spoken out publicly against racism and other injustices and have begun to enact plans to tackle these issues, both internally and externally. Yet before they can make any substantive progress, leaders must first understand how deeply racism is rooted in our institutions and systems. Having a framework like mine, for facilitating more effective conversations about race in the workplace, is also invaluable.

A Brief History of Systemic Racism in the US

The history of racism, injustice, and discrimination in North America long predates the United States itself. For Black people, it perhaps began in August of 1619 when a ship dropped anchor near Point Comfort, Virginia and sold more than twenty African captives to English colonists as slaves. Another two hundred years passed before the movement to abolish slavery and other acts of violence toward Black Americans began. At its inception, this movement was led by Black abolitionists whose efforts hardly appear in US history books. The US Civil War, the Emancipation Proclamation, and the 13th and 14th Amendments to the US Constitution, which abolished slavery and granted Black Americans full citizenship and equal protection under the law, respectively, did not, however, ensure Black Americans full civil rights. Slavery was replaced with a system of laws, referred to as Jim Crow laws, which structured a racial caste system which required all public facilities including businesses, schools, colleges, hospitals, and prisons to be racially segregated and which provided protections for state-sponsored lynchings and other violence toward Black people.

The formal end of racial segregation was the passage of the Civil Rights Act in 1964. But legally banning discrimination has by no means ended racism and discrimination, nor has it created racial equity in US workplaces.

The formal end of racial segregation was the passage of the US Civil Rights Act in 1964. This legislation also banned employment discrimination on the basis of race, color, religion, sex, and national origin. But legally banning discrimination has by no means ended racism and discrimination, nor has it created racial equity in US workplaces. In July 2017, Bass Pro Outdoor World settled a class action law suit, agreeing to pay more than $10 million to Black and Hispanic workers who were allegedly discriminated against in the hiring process. In response to a sex and racial harassment investigation, which included claims that the company retaliated against employees who complained about harassment or discrimination, the Ford Motor Company agreed, in August 2017, to pay more than $10 million. Indeed, the Supreme Court has unanimously upheld the anti-retaliation provision of Title VII of the Civil Rights Act of 1964, which states that it is unlawful to retaliate against applicants or employees who assert their civil rights even if the allegation is unsuccessful or untimely.

So what is different about this moment? Why are corporations around the world responding to the call for racial justice and equity? The senseless killings of Trayvon Martin, Michael Brown, Philando Castile, Eric Garner, George Floyd, Breonna Taylor, Ahmaud Arbery, Rayshard Brooks, Elijah McClain, and many more, and the disproportionately high rate of mortality suffered by Black Americans infected with COVID-19 have certainly contributed. The myth that we now live in a post-racial society and that America’s reprehensible history of racism had ended, a notion to which ever more white Americans succumbed since the election and subsequent eight year presidency of Barack Obama, was left in tatters by these shocking events. President Obama stressed this danger in his 2016 farewell speech: “After my election, there was talk of a post-racial America. Such a vision, however well-intended, was never realistic. Race remains a potent and often divisive force in our society.” The thorny issues of race and racism in the US have been sharply exacerbated by the subsequent election of a president who not only expressed racist ideology during his candidacy, but has continued to do so in office.

What Management Research Reveals About Systemic Racism

Research centered on race in the context of management and organizations has long been marginalized, if not silenced. The limited
The workplace is often toxic to Black employees, who are also discouraged from sharing their negative experiences.

Research that has been published to date on the experiences of Black employees in the workplace nonetheless reveals several recurring themes which demonstrate that the workplace is often toxic to Black employees, and that they are discouraged from sharing or protesting their negative experiences.

First, Black employees often contend with everyday racism, which can contribute to depression, anxiety, and social isolation at work. Everyday racism includes microaggressions or “brief, everyday exchanges that send denigrating messages to people of color because they belong to a racial minority group.” These may include referring to a Black employee as a “diversity hire” which invalidates their qualifications or “articulate” which signals surprise that the Black employee is intelligent. Managers and peers may undermine Black employees and treat them as inferior. They may also simply ignore or dismiss Black colleagues. Black workers may find that companies tokenize and showcase them in marketing materials and diversity events in an effort to prove a commitment to diversity which does not exist.

Second, Black employees are often asked to live in two distinct worlds, keeping their daily and racialized experiences as Black people strictly separate from the world of white Eurocentric professional standards, cultural values, and social norms. To achieve this dichotomy, Black employees often feel that they have to suppress their racial identity and avoid any mention, much less discussion, of race in the workplace. Black employees may therefore need to deliberately create a workplace image which is both authentic and professional. Black women face a particularly fraught landscape, since they are simultaneously extremely visible physically, because they generally differ from their colleagues in both gender and race, and invisible or overlooked, because they do not readily fit into simplistic categorizations of race and gender. Black women are often penalized for wearing Afrocentric (i.e., natural or protective) rather than Eurocentric hair styles, which are sometimes labeled ‘less professional’. At the time of writing, seven states – California, New York, New Jersey, Maryland, Virginia, Colorado, and Washington – have enacted the Creating a Respectful and Open Workplace for Natural Hair (CROWN) Act, which bans discrimination on the basis of natural or protective hair styles including braids, dreadlocks, and twists. There is now a growing movement to enact CROWN legislation in other states and federally.

Despite acquiring educational credentials and workplace training that are equivalent to those of their white peers, Black employees receive less psychosocial support and fewer promotions than white colleagues.

Third, Black employees are less likely to be granted leadership roles. Despite acquiring educational credentials and training equivalent to those of their white peers, Black employees receive less psychosocial support and fewer promotions than white colleagues. Black employees tend to be denied the managerial support, mentoring, and advocacy that are vital to advancing into leadership. They often do not receive critical feedback or they receive feedback which is biased and which inflicts and amplifies harmful racial stereotypes. Even when they are promoted to leadership roles, Black employees are less likely to be viewed and evaluated favorably as leaders, particularly when their leadership methods differ from those of the white men who dominate leadership roles.

Fourth, research has proposed ways of mitigating the harmful effects of racism on Black employees. Across the board, studies find that Black employees’ experience of inclusion and belonging depends not only on changes in workplace structures and culture, but also on changes in social relations. Leaders and colleagues must actively strive to understand the experiences of Black employees, including their experience of coping with negative societal events which affect their communities while simultaneously trying to fulfill their workplace responsibilities. Mentors and managers must support Black employees in cultivating positive racial and professional identities at work while they navigate challenging events. Finally, organizations must restructure hiring and development practices to eliminate the obstacles that Black employees have, until now, been made to overcome in order to earn rewards equivalent to those enjoyed by their white colleagues. These steps are vital for companies which wish to create an environment that welcomes and supports Black employees and their social identities.
Having Difficult Conversations About Race in the Workplace: The RACE Framework

While evidence of racism abounds, formal conversations about it in corporate workplaces have, until recently, been rare. The marginalization of race as a worthy topic (and experience) has historically worked with other forces of systemic racism to make having these workplace conversations difficult. Yet, if we are to mitigate the harmful effects of racism on Black employees, talking about race at work is important.

After extensive analysis of the patterns that make up systemic racism, I have recently developed the RACE framework, designed to help leaders to better facilitate conversations about race in their organizations. RACE is grounded in both academic research and my own experience in facilitating conversations about race in corporate and academic settings. The RACE framework, adapted for this article, works as follows:

R – Reduce anxiety by talking about race anyway. Many people feel uncomfortable talking about race at work. Often, people have been told in compliance training not to mention or consider race in the workplace, to be colorblind. Black employees may also be reluctant to share their experiences of racism for fear that they will not be believed. Conversely, white employees may be unwilling to talk about race out of fear that they will be personally blamed or labeled racist. Yet, research suggests that these fears prevent all of us from becoming better versions of ourselves and better leaders.

Leaders can help employees to feel less anxious and to understand the power of conversations about race, equity, and inclusion. One effective method is to discuss the parameters of the difficult conversations ahead of time. Leaders can invite employees to lay out guidelines they would like to observe to make their conversations about racial differences more effective. Some of the themes I have often encountered during this activity are: building a safe or brave space, practicing respectful engagement, listening actively, and being constructive. Leaders may also wish to ask employees to generate two or three strategies which will help them to respect their parameters or guidelines. In order to build a safe or brave space, employees might have to commit to keeping conversations confidential, refraining from sharing the names or remarks of those who contributed once they have left the conversational space. These strategies are also supported by decades of research on intergroup dialogue, which underlies many methods of facilitating conversations about and across differences.

A – Accept that people are going to have different experiences regarding race. That people experience race in different ways is demonstrated by sociological, psychological, and organizational studies. White people are more likely to believe in colorblindness, a theory which strives to avoid the appearance of bias by scrupulously avoiding any acknowledgement or mention of racial differences. Black people, by contrast, are more likely to value multiculturalism or the acknowledgement, consideration, and celebration of group differences. Black employees are also likely to report feeling invisible or hypervisible on account of their race. Considering the range of experiences of race, we must consider what we gain or lose by making race invisible or hypervisible?

Leaders can help employees to find space in between invisibility and hypervisibility, normalizing race as a meaningful dimension of diversity. Leaders might share some of their own positive and negative experiences with race at work before inviting employees to do the same. Particularly in the context of recruitment, orientation, and evaluation, leaders, including the chief human resource officer, should consider leading discussions about whether and when race should be (in)visible. These discussions are also important whenever the board of directors is planning a CEO succession.

C – Call on internal and external allies for help. Although Black leaders and employees are often seen as the default experts on race and diversity in the workplace, white leaders who are charged with anti-racist agendas must also learn to facilitate conversations about race.

Business leaders can cultivate a network of relationships with a diverse set of internal and external allies (including peers, academics, former colleagues, friends, and clients) who are invested in diversity, equity, and inclusion. This network allows all participants to share tips and resources, disseminating insights on how to facilitate conversations about race in the workplace. Leaders should also encourage employees to develop similar networks and to lean on them for help when it’s needed. Leaders must also recognize that Black workers and women are often penalized for their diversity efforts while white men are often rewarded. Knowing this, leaders should make sure that everyone – including Black workers - is appropriately acknowledged and rewarded for performing vital diversity work.
E – Expect to provide some “answers,” practical tools, skill-based frameworks, and so forth.

In helping employees feel that they can include race in conversations about diversity, equity, and inclusion, it is important to create practical tools and skill-based frameworks.

Leaders can adapt publicly available resources, like the lessons about difficult conversations drawn from intergroup dialogue research. However, they will also need to develop their own concrete and accessible “how to” frameworks. I have developed one such framework, represented by the acronym LEAP, to teach others about allyship.44 L: Listen and learn from your Black colleagues’ experiences. E: Engage with Black colleagues in racially diverse and more casual settings. A: Ask Black employees about their work and their goals. P: Provide Black colleagues with opportunities, suggestions, encouragement, and general support.

It is normal for leaders to question whether they are doing “the right thing” when it comes to addressing issues of race and racism in the workplace. Yet, leaders who hope to eradicate systemic racism must empower employees and provide them with the resources to have productive conversations about race. Grounding these conversations in evidence and good intentions and accepting that people will probably make mistakes or feel uncomfortable, is far better than avoiding talking about race at all.

Endnotes


Leadership: Science, Art, or Craft? What is the best way to develop leaders? These questions are vital to the way leaders see themselves, enact their roles, and run their organizations. They present a range of choices to a CEO who needs to develop young leaders in order to grow a business. Philip Mirvis, Karen Ayas, and CEO Jason Grenfell-Gardner address this question by describing a novel approach to developing effective leaders.

Philip Mirvis  
Global Network on Corporate Citizenship and Social Innovation Lab, Babson College

Karen Ayas  
The Ripples Business Academy

Jason Grenfell-Gardner  
Teligent
This realization inspired Teli-gent to develop a craftsman-ship program to address the shortage of leaders to guide the company through the highly competitive generics market. Managing Teligent’s fast growth called upon its executives to develop basic processes and systems and prepare young graduates, with technical skill but no industry experience or formal business training, to lead. This uniquely designed leadership development program, based on the notion of “leading as craft,” had a profound impact on participants and on the culture of the company.

The notion of craftsmanship came up during our efforts to rebrand the company. After conducting in-depth interviews with all staff about what our company stands for, we identified the three core pillars of our brand: quality, impactful science, and craftsmanship.

My initial reaction to ‘craftsmanship’ was, no way! We’re not making Swiss watches! We’re making creams and ointments. But then I took a fresh look at the work people were doing in all corners of the company—looking at how the compounders make a bulk drug in the manufacturing site, for instance. I could see that the best compounders had this feeling in their fingertips; they knew exactly when to change from heating to cooling. The same was true of the chemist who looked at a chromatogram and immediately understood that something was off. I realized that our business ran on mastery of these crafts which I had overlooked until I was pointed in the right direction. Then I understood that we had to take that magic spark and help it grow.

We needed to make sure everyone in the company could celebrate being an expert in their craft and understand how those crafts interacted and contributed to the whole. We needed to train leaders who focused on perfecting their craft of leadership, developing themselves and those around them.

- from a conversation with the CEO

Leadership Education
In developing new leaders, companies perpetually face a twofold challenge: to make the right choices about investments and programs and to ensure that both the participants and the organization benefit, in tangible results as well as esprit de corps. These decisions are informed by many considerations: what type of program, how long, and for whom? Use a university curriculum or design your own? How much theory versus practice? Should the training focus on “hard” or “soft” skills?

MBA and other university-based education programs stress the science of leadership. This focus is apparent in leadership texts that emphasize empirically-validated theories and in calls for evidence-based practice that relies upon proven methods to yield predictable results. Classes typically focus on facts and analytics, as opposed to exploration and judgment, while case studies present a technical-functional rather than an integrative management perspective.

So what about the art of leadership? Some argue that creative and artful action is born of innate talent, while others contend that it can be learned. K. Anders Ericsson makes a case for “deliberate practice” which he defines as “focused, goal directed and where you can receive constant feedback.” Artful techniques of leading include envisioning, active listening, storytelling, and group problem solving which students can practice in role-plays or simulations, while educators critique their performance.

In learning leadership as a craft, real world practice is essential. Project-based learning allows people to develop and refine practical leadership skills in real-life situations.

Designing a Craftsmanship Program
Craftsmanship: “A quality that is honed, refined, and practiced over the course of a career. Requires
a great deal of time, discipline, patience and effort." History reveals the defining methods for training craftspeople. The weavers, dyers, glassmakers, iron-workers, goldsmiths, and bakers of medieval times learned their crafts through apprenticeship. Their master would instruct them and also serve as a mentor and role model. Apprentices worked under the direct supervision of a master until they were ready to become journeymen, working more independently and developing their skills through practice and the guidance of others. Finally, at the master-craft stage, they learned how to manage and lead a craft practice. Even mastery was not a solo undertaking: masters joined guilds and collectively regulated the quality of work and the training of future craftspeople.

How, then, can the methods of craftsmanship be applied to educating future business leaders? To develop our program, we combined the best elements from science and art approaches to leadership and leadership education, including academic theory, case studies, experiential exercises, and studio practice. We then added elements of craft education like hands-on experience, guidance from mentors and role models, and a graduated performance progression, from apprentice to master.

Richard Sennett, author of *The Craftsmen*, also cites the importance of non-verbal knowledge and considers “struggling with the problem” to be essential to craft work. Naturally, we had to attend not only to the content, settings, and logistics of our program, but also to its sequence, pace, and energy flow throughout.

Consider how all these factors contribute to the design of a leadership development program that benefits both the participants and the business.

**Program Logic and Content**

Every business leader and professor has his or her own perspective about what leadership is, how it should be taught and developed, and what pedagogical methods work best in given situations (setting, company, participants, etc.). That’s why we designed our program to be personalized and customized. With an eye to developing not only individual but also collective leadership capabilities, we approach leadership education on three levels: 1) leading oneself; 2) leading others and 3) leading the business. Our goal is to create what Joe Raelin describes as a “leaderful” company culture.

Our program follows the three traditional phases of craft education—apprentice, journeyman, and craftsman—with each level building upon what came before. Sessions combine conceptual, experiential, and practical learning. Apprentices are introduced to self-awareness, different leadership styles, conflict and communication, leading a team, and so forth. As participants progress to journeymen and then craftsmen, they learn to lead with presence and make decisions in uncertain situations.

**Leadership: Science, Art, or Craft?**

Scholars have made a case for leadership as a science, an art, and a craft:

**Leadership as Science:** Analysis, Prediction, Control. This was scholars first take on business leadership, based in Frederick Taylor’s studies of “scientific management” and Henry Fayol’s administrative principles, reaching its apotheosis in Herbert Simon’s “Administrative Man” who excludes value judgments and concentrates on “facts.” Exemplars include Robert McNamara at Ford in the 1950s who applied systems analysis tools to analyze and forecast trends and Jack Welch in the 1980s who used financial acumen to meet GE’s quarterly earnings targets, buy-and-sell companies, and train thousands of six-sigma “black belts.” Paul Brooker and Margaret Hayward make the case that “rational” leadership has been at the core of iconic companies like Intel, Toyota, Walmart and now Facebook and Amazon.

**Leadership as Art:** Intuition, Vision, Creativity. In 1957, Philip Selznick challenged the primacy of technical-rational leadership by arguing that under conditions of uncertainty and change, creative leadership was needed to renew an enterprise. This view aligned with James McGregor Burn’s writings on transformational leaders who “address their creative insights to potential followers, seize their attention, spark their interaction,” and with Warren Bennis on vision: “The manager has his eye on the bottom line; the leader has his eye on the horizon.” Exemplars are Steve Jobs and Warren Buffett—I am not a business man, I am an artist.” Nancy Adler applies an aesthetic lens to “leading beautifully.”

**Leadership as Craft:** Experience, Practice, Pragmatism. Chester Barnard and Mary Parker Follett stressed that authority is not a function of position, but is negotiated between leaders and followers in their everyday interactions. Connecting this to craft, Steven Taylor writes: “Leadership is the craft of working with other humans to get things done. In the same way that a carpenter learns to use tools and techniques to work wood into something beautiful and functional, a leader can learn to use tools and techniques to work their connections with others to develop beautiful and functional relationships.”

Biographies of Abraham Lincoln, Thomas Edison and Anita Roddick depict leaders who learn by doing, hone their skills through practice and experience (successful and not), and are resourceful and resilient.

Effective leadership embodies all three types. While leaders who are hyper-rationalists can be typecast as technocrats, the type’s paragons (e.g., Barack Obama) also attend to the human side of leading. The leader as artist may often be a maverick (e.g., Elon Musk), but innovative firms like 3M, Tata, and Netflix make heavy use of metrics and operate in a technical-rational mode. And while craftsmen are pragmatic doers, Mintzberg finds that successful executives blend logic and imagination with their practical experience.
situations. Business inputs include deeper dives into the industry, strategy, and core functions like product development, manufacturing, quality, and the like. Real-life case studies, presented by company leaders, become more complex, call for more nuanced thinking and judgment, and drive participants to wrestle with strategic, operational, and ethical dilemmas.

1. **Company diagnostic:** We begin to design a program by interviewing top executives and using surveys, focus groups, or interviews to gather input from employees at every level and function. This diagnostic allows us to understand the current state and future direction of the organization, including market, strategy, operations, workforce, and culture, as well as the associated performance gaps. We can also identify the knowledge and abilities needed to fill those gaps; gauge the interest, ability, and drive of the top team to groom the next generation of leaders; and assess the readiness and motivation of the staff.

2. **Leader-Teachers:** One of the distinctive features of a craft program is that executives serve as the master craftspeople of their trade and assume multiple roles:
   - **Teachers:** Core to the program is that executives teach industry and business knowledge themselves to ensure that the content is relevant, practical, and company-specific. This means that execs must not only be experts on their subject, but also be able to communicate effectively. External faculty provide each exec with guidance and support to ensure that the material they present is digestible and includes interactive learning components.
   - **Mentors:** Members of the top team act as mentors throughout the program. All participants are assigned an executive mentor (from outside their area of responsibility) who meets with them prior to and throughout the program. Mentors offer an understanding ear and sound guidance while helping participants to design a business project and devise their own leadership development plan. Most of these interactions are structured and managed by the mentee.
   - **Project Champions/Team Coaches:** In the journeyman and craftsman phases, participants tackle a cross-functional and then an enterprise-wide business project. Whichever top team member “owns” the problem at hand serves as project champion. Champions help their team to refine their mission statement, develop a project management plan, and deliver results. They also coach their team throughout the project on its technical aspects, and on dealing with interpersonal and team issues, political dynamics, resistance to proposed changes, and more.
   - **Role Models:** Finally, executives are tasked with being role-models for future leaders. They share their own leadership experiences and self-assessments, talking candidly about their successes and failures in business and beyond.

The hope is that participants will not only use what they learn in their own leadership, but also gain a deeper appreciation of what it takes to master a craft by witnessing the passion and dedication of craftspeople at work.

3. **Meeting Craftspeople:** Teachers come in many forms. In our quest to expand business leadership students’ understanding of leading self, others, and an enterprise, Ayas and Mirvis have introduced them to community, civic, and spiritual leaders, masters of martial arts, yoga, and zen, and artists and inventors of all kinds. Each time we conduct this kind of program, we make sure participants interact with exemplary crafters outside the company, learning how they developed their craft and even taking the first steps toward learning it. The hope is that participants will not only use what they learn in their own leadership, but will also gain a deeper appreciation of what it takes to master a craft, witnessing the passion and dedication of craftspeople at work.

4. **Project Based Learning:** Project-based learning is integral to developing leadership as a craft. Our participants are confronted with a problem to which there is no predetermined solution. They must conduct research, communicate with those who have a stake in the project,
design and experiment with possible solutions, deal with unexpected events and errors, manage their time and relationships, and reach a solution, all on their own. Apprentices undertake a business improvement project within their area of responsibility. Journeymen face a cross-functional challenge, working in small teams. Craftsmen are given an assignment for the whole group that comprises nearly every element of the business. The selection and scope of these projects is critical to the success of the program. Participants, executives and faculty cooperate in front-end project development and in periodic progress reviews. All participants receive training in project management, engaging with stakeholders, and relevant diagnostic and planning tools.

Unlike a university program, where faculty run the show, in this case the CEO supervised the overall program, hosted each session, and worked with the external faculty and his own leadership team to design and deliver content relevant to his company.

5. **External Faculty**: External faculty play an important role, pulling together all the pieces mentioned above to ensure the integrity of the program’s overall logic and content as well as its effective delivery. While the leader-teacher model is gaining popularity in development programs, few executives are schooled in designing and delivering leadership programs and most have neither the time nor the inclination to learn. Exhibit 2 highlights how external faculty, with their knowledge of craft leadership development, contribute to the program.

We now turn to the case of Teligent, and the moment when its CEO, Grenfell-Gardner invited Ayas and Mirvis, as external faculty, to design a craftsmanship program for his company. Unlike a university program, where faculty run the show, in this case the CEO supervised the overall program, hosted each session, and worked with the external faculty and his own leadership team to design and deliver content relevant to his company. Together, the three of us drew on the aforementioned tools and techniques to design and run the program. Along the way, we discovered a few errors and redesigned a few components.

**Craftsmanship at Teligent**

Teligent is a generic pharmaceutical maker based in New Jersey with operations in Canada and Estonia. It has an annual revenue of $70 million and employs about 200 people. Driven by science, the company produces an ever-increasing range of topical, injectable, complex, and ophthalmic products. Teligent is growing rapidly, with dozens of new products filed with the FDA, the addition of clean room manufacturing capability in the U.S., new facilities in Estonia, and aspirations to do more.

When Grenfell-Gardner became CEO in 2012, Teligent employed twenty-eight people. Within four years the company grew significantly in revenue, employees, and complexity. Our company diagnostic revealed that, as is not unusual in small companies moving into rapid growth, there were mishaps, firefighting (that is, getting bogged down in immediate crises at the expense of moving forward), and a sense of too few hours in the day to achieve ambitious goals. This pressure, coupled with a lack of clarity about individual roles and responsibilities, produced uncertainty about who was responsible, start to finish, for getting products out the door. It also fed a silo mentality between different functions.

Nonetheless, the company had introduced the mantra “work hard and be nice to people” early on, which kept its culture fairly positive. Interviewees described quality, pride, and teamwork as operational norms. “Crazy, hectic, but positive,” was how one employee described it. And indeed, despite its internal chaos and small size, Teligent was in the top ten in number of new drug applications (NDAs) filed in 2016, next to generic giants such as Teva.

**Exhibit 2: External Faculty Contributions**

- Conduct company diagnostic and prepare organization for program.
- Develop program content (concepts, readings, pedagogy, tools) and flow.
- Coach leader-teachers on session design and delivery.
- Help to identify and prepare sessions with external craftsmen.
- Help in participant project selection, refinement, and project management.
- Help to facilitate sessions and improvise when necessary.
- Monitor experiences and participant learning.
and Sandoz. Our goal was to work out how this success could be multiplied.

The company was at a point at which it required more structure, processes, and systems as well as more business-minded leadership at every level if it was to successfully scale up. Lead employees and supervisors were generally functional experts with no general management training or experience. They lacked knowledge of the industry and, on the U.S. side, were often immigrants or first generation Americans who were still absorbing American work mores and business culture. Many had strong backgrounds in science, but no schooling in interpersonal relations, teamwork, or leadership skills.

Grenfell-Gardner gravitated to the craftsmanship program as a way to groom his next generation leaders and create an informal network of leaders binding the company together. He recognized that, in the short term, the program would add “one more thing” to the overloaded agendas of participants and create further stress in the organization by taking them away from their usual functions. Nonetheless, he was convinced that in the long term this program would help participants to perfect their craft as leaders and engender a tightly knit group who, together, could cope with the challenges of growth and sustain a positive culture as they scaled up.

**From Design to Delivery:** The Teligent craftsmanship program was built on the designing components enumerated earlier. Each phase—apprentice, journeyman, master craftsman—lasts six months. In moving from design to implementation, the designers carefully considered several key issues.

**Top Team Participation and Preparation:** The program calls for the top team to act as leader-teachers, master crafters, role models, and project champions. The execs at Teligent were overloaded, stressed, and wary of taking on new responsibilities. To encourage them to buy in, we hosted a deep and open discussion about the diagnosis to demonstrate gaps in current performance and highlight the need for leadership training. This conversation persuaded the top team to reset its priorities and focus on the project. Next, they participated in team building keyed toward craft leadership, program goals and content, and on understanding the roles they would play.

When it comes to teaching, executives are not all equally adept at conveying knowledge of their craft, nor at monitoring time, managing a room, and keeping tired participants awake. The leader-teachers needed help with designing sessions, case materials, and exercises and with managing the flow of the classroom. In nearly every session, they presented a specific, real-time business issue for which participants, in small, varied groups, analyzed and debated possible solutions. The session leader and CEO offered feedback on their thinking and conclusions. At one session, the Chief Science Officer introduced participants to the analytic tools used to determine which drugs to develop, had them scour the industry drug registry, and make and justify their recommendations. Some of the new drugs they selected eventually went to new product development. In another session they were asked to debate the company’s sales structure.

**Participant Selection:** The original plan was to select apprentices from a pool recommended by members of the top team. Because this method engendered suspicions of favoritism, we decided to open up the selection process and offer all employees the opportunity to make a case for their own
admission. These applications revealed some hidden talent, to the benefit of the company. Once the apprentices graduated, they were candidates to become journeymen. Not all continued on: some preferred not to go on while others were deemed unready to move forward. Most of those who did not become journeymen were offered other development opportunities. This same process was used when participants approached the master craftsman level.

**Project Selection:** At the outset of the program, apprentices were asked to propose projects in their own areas of responsibility which would: 1) be important to the business; 2) expand their leadership skills; 3) help people in their area to develop; 4) be achievable within five months; and 5) show tangible results. As we expected, some of the ideas were half-baked or unrealistic and the mentors helped to improve them. In some cases, too, progress was uneven, with the bulk of the real work put off until the final months, and we discovered that requiring participants to give a public mid-session presentation of their product helped everyone to keep up. It also inspired new sessions in which participants were taught how to organize and deliver presentations, and how to tell a story.

The projects apprentices chose tended to focus on process improvements: the launch of safety training, streamlining changeovers on packing lines, improving vendor qualification, standardizing drug application procedures, and so forth. Journeymen chose projects which required multi-function teams: redesign a warehouse, open a new quality laboratory, smooth the transition to SAP software, select and screen alternative suppliers. The master craftsmen participants all worked together to devise an entry strategy for the European market.

**Meeting Craftspeople:** This aspect of the program was the most innovative and perhaps the most rewarding. Employees participated in ice-carving, improv theater, graffiti art, and tai chi as well as sessions with brewers and watchmakers, and visits to the FDA and iconic businesses like W.L. Gore. Apprentices spent a day at the French Pastry School in Chicago, making goodies and comparing chemistry formulas with chefs. On graduation day, they enjoyed an inspiring conversation with Kyle Maynard, a limbless mountainer, and rang the closing bell at Nasdaq. Although we had to scour our respective networks to enlist these crafters and overcome a variety of logistical challenges (snow, traffic, bus breakdowns) to bring it all together, the results were well worth the effort.

**Leading as craft:** The program introduced participants to a vast array of concepts, experiences, and practices—including both rational-technical and artistic approaches. But what about teaching leading as a craft? Certainly the projects and interactions with craftspeople from different walks of life served this end. But we were also attentive, in our workshops, to what Eva Poole aptly calls “leadersmithing.”

- **Craft Thinking:** When leader-teachers led discussions about real-life cases, the participants were constantly challenged to reach beyond their function and “think like a CEO.” And having the actual CEO critique their thinking reinforced the lesson!
- **Craft Doing:** Through exercises on leading a team, persuading reluctant stakeholders, managing conflict, and dealing with resistance to change, participants practiced leadership skills and got feedback from both peers and execs.
- **Craft Identity:** Participants constructed and shared an

<table>
<thead>
<tr>
<th>Sample Apprentice Projects at Teligent</th>
<th>Selected Benefits/Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Creating a talent assessment framework</td>
<td>• HR Costs ↓</td>
</tr>
<tr>
<td>• Streamlining the drug submission process for the US &amp; Canada</td>
<td>• Cycle time reduced 40 percent</td>
</tr>
<tr>
<td>• Designing and delivering training for machine operators</td>
<td>• Efficiency ↑</td>
</tr>
<tr>
<td>• Creating a vendor qualification process</td>
<td>• $12,000 per vendor</td>
</tr>
<tr>
<td>• Developing standard procedures for quality control</td>
<td>• Cycle time reduced 20 percent</td>
</tr>
<tr>
<td>• Creating an inventory system for labs to track supplies</td>
<td>• 100 percent improvement</td>
</tr>
<tr>
<td>• Globalizing regulatory processes for injectables</td>
<td>• Faster approvals</td>
</tr>
<tr>
<td>• Mapping the drug submission process</td>
<td>• Reduce deficiencies</td>
</tr>
<tr>
<td>• Improving machine set up times by 25 percent</td>
<td>• Savings = 25 percent person hours</td>
</tr>
<tr>
<td>• Implementing preventive maintenance for metrology</td>
<td>• Savings = $100,000</td>
</tr>
<tr>
<td>• Developing an audit template for suppliers</td>
<td>• Errors reduced 600 percent</td>
</tr>
<tr>
<td>• Eliminating or reducing NDA questions</td>
<td>• Savings = 30 percent person hours</td>
</tr>
<tr>
<td>• Creating a process to acquire new instrumentation</td>
<td>• Reduce Outside Testing</td>
</tr>
<tr>
<td>• Streamlining the procurement process</td>
<td>• Cycle time +30 percent</td>
</tr>
<tr>
<td>• Creating a new website for Teligent Canada</td>
<td></td>
</tr>
</tbody>
</table>
The emphasis throughout was on reflective practice, encouraging participants to make journal notes about their experiences in-class, on-the-job, and in their projects, and to share them with their mentor and peers, periodically highlighting them through personal leadership stories. This practice, in which tacit knowledge is made more explicit and becomes fodder for collective learning, is in keeping with the principles of work-based learning endemic to craftsmanship.

The organization became more human as personal connections grew stronger.

The Learning Experience
To more organically express the flavor of the craft learning experience, we took notes about program sessions and participant reactions throughout.

Apprentices: “When the apprentices gathered for the first session in Atlantic City the room was unusually quiet and everyone anxious about what was to follow,” recalled one of the twenty-nine participants. “Looking back now, we can see that a special journey was about to begin.” As the apprentices assembled for the first time, they expressed their concerns about the demands on their time, being away from work for two days a month and, in some cases, about having to speak up despite having imperfect English. A session offering an overview of the pharmaceutical industry left some striving to think like CEOs but others wondering “what am I (a chemist or warehouse supervisor) doing here”?

But the participants gradually warmed as they shared their stories and DiSC profiles with one autobiographic timeline to identify the experiences that had shaped their leadership outlooks from childhood on. They also completed a DiSC profile (measuring dominance, influence, steadiness and conscientiousness) to inform their picture of themselves. Executive mentors further reinforced their individual craft identity.
another, their mentors, and their CEO. As each described their own work and its associated leadership challenges, their minds expanded with broader business knowledge. They found working with craftspeople to be novel and engaging: “Take ice sculpting—you look at that huge block of ice and say no way—but then you start carving and magic happens.” A session on culture asked each participant to bring along an object that, to them, embodied Teligent and to describe its significance. They brought a QC instrument, a hairnet, an approval from the FDA, a football jersey, a letter of thanks from a patient. “I take extreme pride in what we make at Teligent. Regardless of the paycheck, the greatest feeling is knowing that what you do every day is helping someone’s life.”

Before presenting their final projects: “The anxiousness was frightening but the group support was encouraging” commented one. Others reflected on the overall experience: “I was not looking for a job, I was looking for a home and I found it here”; “Skills I learned helped me tremendously, individually and in practice, and I saw the impact in the organization.”

Journeymen: Roughly half of the apprentices moved on to the journeyman program. Their self-knowledge grew as they received 360° feedback. Teamwork was now essential to their success and their leadership skills were tested in cross-functional projects championed by Teligent execs. A visit to inner Detroit opened their eyes to the problems in health care delivery that affect poor neighborhoods and sparked a lively conversation about socially responsible leadership. “I am absolutely a better person,” said one journeyman; “(I) Learned so much from the visits. Understood that leadership comes in so many ways,” reflected another.

Interestingly, many participants found that their leadership lessons from the program also affected their lives off the job. One apprentice graduate described how her newfound skills helped her to become a better parent.

Master Craftsmen: The eight people who were selected to continue into the master craftsmanship phase were entrusted with a global project that required strategic thinking about expanding into new areas. It included technical components (analyzing and synthesizing complex and varied data), artistic elements (preparing to deliver health care in an unfamiliar market and culture), and craft work (creating a plan and persuading the top team and CEO). “Interesting and exhausting” said one participant. “Working across borders and time zones was challenging” said another. “The program offered a great opportunity to gain deep insight into the business while honing our leadership skills.”

Interestingly, many participants found that their leadership lessons from the program also affected their lives off the job. One apprentice graduate described how her newfound skills helped her to become a better parent. Another became a leader at her son’s school. A journeyman graduate talked about taking on a new leadership role with the boy scouts.

The Guild of Craftsmen
In medieval times, a guild functioned as a vocational school, a craft union or association, and a certifying body which ensured the quality and integrity of the goods and services provided by its members. At Teligent, all program participants were invited to join a Guild of Craftsmen within the company. Graduate master craftsmen govern the Guild and represent it. They help to recruit, select, and socialize with new trainees, contribute to the leadership development program, and serve as cultural ambassadors both inside and outside the company. As one told us, “We now have a better understanding of who and where we are and what it means to be part of the Teligent team.” For the CEO the Guild also creates a forum in which he can be totally open, sharing his feelings so that people understand where he is coming from. He can take off his armor and invite honest appraisal.

From a diverse and divided group of people who barely knew or spoke to each other, a powerful community of leaders emerged.

Impact of the program
The program described above represents a heavy investment, not just financially, but also in the effort and time spent by the CEO and the top team. So is it worth it? While it is impossible to calculate a precise monetary return, the benefits from the program are myriad.

1. Individual growth: As the participants’ remarks testify, the program contributed perceptibly to their personal growth and development of leadership skills (next page – reflections on the program). It also helped many of them to lead more fully in other parts of their lives. Their mentors’ comments highlight the progress participants made in all aspects of the training (next page).
2. **Connection to the top team:** Members of the leadership team developed as mentors, teachers, coaches, and role models. The program brought them closer to young leaders throughout the organization, rather than just those reporting to them directly. Grenfell-Gardner recalls one early session in which he sat on the floor in a crowded room to project slides for a fellow executive. His willingness, even as CEO, to help with this simple task proved a valuable lesson. The organization became more human as personal connections grew stronger.

3. **Breaking down silos and forming a community:** From a diverse and divided group of people who barely knew or spoke to each other, a powerful community of leaders emerged, ready to work together to build the company’s future. Everyone gained a better understanding of the trade-offs necessary to organizational decisions and new insights into the challenges their colleagues faced. This new perspective helped to erase the tribal splits that can occur between departments and built networks that spanned all levels and functions.

4. **Sustaining culture:** The Guild of Craftsmen is the keeper of the company culture. All members, whether apprentices, journeymen or master craftsmen, act as cultural ambassadors, guarding the values of Teligent and promoting behaviors that nourish its culture.

5. **Continuous improvement mindset:** The apprentices took ownership of the company’s problems and their solutions. They found ways to improve performance by improving process, adding both value and efficiency. No problem was viewed as someone else’s. The program provided them with the tools to bring this perspective to their daily work. They tackled problems beyond their personal expertise, their area of function and even their familiarity. A team of four journeymen (two chemists, a regulatory expert and an IT manager) led a herculean effort to build a warehouse to consolidate six smaller locations.

---

### Reflections on the Craftsmanship program

#### Leading Self:
- "I was able to see a transformation within myself and my confidence in being a leader."
- "I can now express my thoughts and opinions in meetings without backing down."
- "I learned about listening and then reacting to what people say."
- "Helped me become more self-aware and use my strengths."
- "I learned to set personal goals for myself and achieve them gradually."
- "Improved use of available time, scheduling time to work on my projects."

#### Leading Others:
- "I developed a better understanding of how to interact with others in the business world."
- "Participating in activities provided insight and opportunities to develop stronger leadership skills."
- "I can be a little less introverted. I have had some reassurance in myself."
- "Gained a better understanding of everyone's role in our processes."
- "I am able to think quicker on my feet and as a result have become more persuasive when presenting my point of view."
- "Many of my peers in the program listened to my input and that was refreshing."

#### Leading the Business:
- "The LEAN exercise helped to mimic real-life issues."
- "I have developed a network of internal contacts and resources that I did not have before."
- "Got a clear understanding of (the) vision for the future and growth strategies and understand challenges associated with company growth."
- "Connected with departments outside of my functional area and improved my individual impact within the company."
- "Learned more about the pharmaceutical industry as well as Teligent's business model."
- "I can also look at a project with a broader perspective (view from the balcony)."

---

**Mentor Comments to Graduate Journeymen**

- "What a transformation! From a shy quiet chemist to a dynamic leader, taking the bull by the horns, embracing ownership and really showing how to get the most out of this great program!"
- "Thrilled to see you continue maturing and growing to manage and coach others. You have a special humility to know your limits and now more courage to push further."
- "You are a bright person, with a great entrepreneurial spirit! Insightful questions and engaging discussion, combined with technical knowledge, equal a great future!"
- "You had the opportunity to let your obstacles stand in your way, but instead you have persevered despite cultural and physical challenges. I sit here today in awe of your strength, and can only hope it is contagious."
- "You have an amazing drive and enthusiasm. You have a lot to do in the coming years, but I'm confident that you will continue to step up."
- "The first job of a leader is to inspire trust in others. You have met your critical mission."
- "I'm confident that you will continue to step up. You have a lot to do in the coming years, but I'm confident that you will continue to step up."
- "You had the opportunity to let your obstacles stand in your way, but instead you have persevered despite cultural and physical challenges."
- "I sit here today in awe of your strength, and can only hope it is contagious."
- "Connected with departments outside of my functional area and improved my individual impact within the company."
- "Learned more about the pharmaceutical industry as well as Teligent's business model."
- "I can also look at a project with a broader perspective (view from the balcony)."

---

**They were just waiting to be given the permission to grow.**

6. **Tangible results:** The program’s business improvement projects brought the company significant value and, in some cases, increased efficiency and led to big savings. One of the apprentices created a process for vendor selection which saved the company hundreds of thousands of dollars. Journeyman projects included the design...
and construction of a new lab, a warehouse at a new facility, and the implementation of new systems and processes. The master craftsmen project, meanwhile, contributed tangibly to the company’s growth strategy. Indeed, all Guild members contributed to cost cutting initiatives that saved the company thousands of dollars.

Reflecting on his experience with the program, Grenfell-Gardner summed it up aptly: “I realized that there was so much latent value in the organization waiting to be unleashed. They were just waiting to be given the permission to grow.”

Future Applications
This novel approach to leadership education invites further experimentation. We believe that the principles of developing leaders as craftsmen can be applied in any organization and that our program can be adapted in length and content according to that organization’s needs. In university education, there is a movement to bring arts-based and studio pedagogy into leadership classrooms and, in the spirit of craftsmanship, to make work-based learning an integral part of curricula. Companies, too, are moving toward using leader-teachers in executive programs, emphasizing mentoring and role-modeling, and using project- and service-based learning to train future executives.

For those looking for background information on leading as craft, we have included a list of recommended books below. For those looking to craft new forms of leadership development, we wish you the best.

Recommended Books on Leadership as Craft

Endnotes
Time to Lead is a book is about great men and women, their actions in leadership that have withstood the test of time, what we can learn from them—and the lessons that are relevant for us here and now.

For seasoned and aspiring leaders, Steenkamp includes assessment tools, takeaways, leadership principles, and open-ended, reflective questions to encourage, enrich, and empower readers to utilize the same tactics when facing daunting challenges in their own lives.

“This book will give you the tools to deepen your wisdom, clarify your thinking, and improve your outcomes as your own story of leadership unfolds.”

—Major General Cameron G. Holt, Deputy Assistant Secretary of the Air Force
Karol Wasylyshyn and Raj Gupta provide an in-depth look at a long-term leadership development process at Rohm and Haas that was dubbed “one of the best CEO universities” in the world. On a deeper level, they provoke reflection on the value of connecting holistically with high potential employees and on how, in doing so, we can maximize both human potential and business growth.
We need to go inside-out. We need to assess the whole person, not just one’s profile of leadership competencies. We need to establish real relationships with these people, and they need to know themselves and understand what influences their leadership behavior in good times and bad.-- Mark X. Feck

Between 1988 and 2008 Rohm and Haas, a global chemical manufacturing company, offered seventy high potential leaders the chance to participate in a customized leadership development program called Leadership 3000. After the company’s surprising sale to Dow Chemical in 2008, more than 20 percent of participants went on to become CEOs elsewhere. Egon Zehnder, a global management consulting and executive search firm, assessed leaders on both sides of the deal and declared Rohm and Haas the “best CEO university” it had ever encountered. Ten years later, Botelho and Kos concurred with Egon Zehnder’s assessment and included Rohm and Haas among the few companies they termed “stealth CEO factories.”

This is the story behind the Rohm and Haas legend. It is more complete than anything previously written on the subject. Mark X. Feck, who was the Rohm and Haas chief human resources officer and co-creator of this development initiative, captured both the essence of the work and his own commitment to the participants in the introductory quote. The company’s process, rooted in psychology, was intended to go deep, providing participants with fresh insights which would make them ever more effective leaders. It viewed leaders holistically, considering their challenges at work within the full context of their lives. While the process was based on a four-phase model that unfolded over the course of a year, it was also open-ended and fostered ongoing relationships with the participants. Senior leaders at Rohm and Haas consistently used certain management practices to accelerate the development of highly talented candidates. These developing leaders were given early opportunities to expand their abilities. They were placed in roles with significant authority and exhorted to think and act like CEOs. Rohm and Haas used a robust annual talent review process and ensured that likely candidates had the chance to work as expatriates. In keeping with Rohm and Haas’ reputation for building strong global leaders, most of those who later became CEOs elsewhere had succeeded in at least one assignment as expats. The company’s aforementioned managerial practices and leadership development helped to drive two of the its boldest initiatives: an expansion into the Asia Pacific region which drove global sales from 5 percent to 25 percent and the creation of the Electronic Materials division that grew from $150 million to nearly $2 billion. Indeed, Rohm and Haas became the second-best performing company in the S&P between 1999 and 2009, largely as a result of these two initiatives. In short, the Rohm and Haas story is not about the newest methods in leadership development but about the most enduring. This is how the process evolved.

The Development of the Process
In the mid-1980s Larry Wilson, then chairman and CEO of Rohm and Haas, was facing slackening growth. Beyond strategically addressing portfolio issues, Wilson believed that top nominal and functional leaders would need to become more aggressive in pursuit of growth opportunities. Wilson’s chief human resources officer, Mark X. Feck, worked with Dr. Karol Wasylyshyn, a consulting psychologist and one of the authors of this paper, to create and implement a four-phase program for developing the employees with the highest potential to be leaders (Table 1).

A number of interrelated factors contributed to the twenty-year life of the resulting program, Leadership 3000, which was built upon strong guiding principles, methodology, and practice considerations and which emphasized the behavioral dimension of leadership (Table 2).

The Guiding Principles of Leadership 3000: Ensuring Sustained Traction
We designed Leadership 3000 around three guiding principles to ensure that its participants engaged with and retained what they had learned: the imprimatur and active involvement of the CEO, a holistic approach, and clear confidentiality boundaries.

Active participation of the CEO: By actively participating in planning and enacting Leadership 3000 meetings, the CEO and other C-level leaders had the chance to convey their executive wisdom. Specifically, in the I’ve-walked-in-your-shoes spirit of this work, C-level leaders shared knowledge from their own careers with participants. In so doing, they candidly described less obvious tactics, interpersonal dynamics, and the grittier political aspects of effectively leading a global business with a geographically dispersed team. In short, “The ongoing engagement of the CEO and other C-suite executives in rigorous and thorough follow-up ensures the necessary motivation and commitment of all involved. Leadership 3000 participants wanted to show...
well and senior executives wanted to convey the lessons they had learned in ways that would accelerate business success.”

A holistic approach: In order to get Leadership 3000 participants fully engaged, we had to design a developmental experience deeper than most, by offering them fresh insights about their own leadership, and fuller than most, by seeing and interacting with them not just as executives but as peers, husbands, parents, and friends, that is to say, as whole people. Wasylyshyn encouraged participants to explore their holistic reality through questions such as: How do your work and personal lives interact? What might you change to become healthier, get more sleep, be happier and more connected with the people closest to you? If you need to make changes in the personal sphere, how will they make you a more effective leader? Participants often gained important insights and, by exploring them through candid and constructive discussion, maintained their traction in the development work. Wasylyshyn and Feck also designed an optional Spousal Module to help participants explore these issues more deeply.

Fostering trust and maintaining clear confidentiality boundaries: Wasylyshyn and Feck faced a considerable hurdle right at the outset because they had to find a way to keep participants receptive while in the presence of their boss and the CEO, or some other member of the CEO’s leadership team. They therefore used several methods to encourage participants to be receptive and candid. First, each participant received a written invitation that emphasized the developmental (rather than evaluative) nature of the process. Often their boss or the Chief Human Resources Officer preceded or quickly followed this invitation with a personal conversation emphasizing that the Leadership 3000 participant was the client and the company was the sponsor. The client therefore owned whatever data was gathered during this development work.

While this confidentiality was key in fostering the trust of participants, leaders also made clear that the sponsor would receive information about each participant’s strengths and particular areas of development, but that the core data from which this information was drawn belonged to the client. Likewise, while the client was free to share their information with anyone, the external consultant was not. And while it was considered appropriate for an HR representative to weigh in on key personnel decisions about participants, they did so as HR, not as a Leadership 3000 process owner.

Table 1: Rohm and Haas Leadership 3000 - A Four Phase Model for Developing High Potential Leaders

<table>
<thead>
<tr>
<th>PHASES</th>
<th>TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1: Multifaceted Data Gathering</td>
<td>Life history</td>
</tr>
<tr>
<td></td>
<td>Psychometric Testing:</td>
</tr>
<tr>
<td></td>
<td>• Myers-Briggs Type Indicator</td>
</tr>
<tr>
<td></td>
<td>• Watson-Glaser Critical Thinking Appraisal</td>
</tr>
<tr>
<td></td>
<td>• Life Styles Inventory</td>
</tr>
<tr>
<td></td>
<td>• Revised NEO Personality Inventory (NEO PI-R)</td>
</tr>
<tr>
<td></td>
<td>• BarOn Emotional Quotient Inventory (EQI)</td>
</tr>
<tr>
<td></td>
<td>• Rorschach</td>
</tr>
<tr>
<td></td>
<td>• Hermann Brain Dominance</td>
</tr>
<tr>
<td></td>
<td>• Guilford-Zimmerman Temperament Survey</td>
</tr>
<tr>
<td></td>
<td>• PRF-Form E</td>
</tr>
<tr>
<td></td>
<td>Organization input – targeted interviews</td>
</tr>
<tr>
<td>Phase 2: Synthesized Feedback</td>
<td>Meeting 1 with external consultant; review of life history themes and psychometric data</td>
</tr>
<tr>
<td></td>
<td>Meeting 2 with external consultant; review of targeted interviews</td>
</tr>
<tr>
<td>Phase 3: Comprehensive Action Planning</td>
<td>External consultant facilitates meeting with participant’s brain trust (CEO, CHRO, and participant’s boss)</td>
</tr>
<tr>
<td>Phase 4: Focused Follow-up</td>
<td>External consultant facilitates meeting with participant’s brain trust to evaluate participant’s progress on development plan</td>
</tr>
</tbody>
</table>

Leadership 3000 Methodology: Unearthing Applicable Data and A Four-Phase Model

Leadership 3000 remained valuable throughout its twenty-plus years at Rohm and Haas because it was rooted in the identification of suitable participants and in a four-phase model.

Rohm and Haas identified Leadership 3000 participants through an annual review of talent conducted by senior representatives of HR and top corporate leaders. As Wasylyshyn once put it, “This linkage between the company’s talent management strategy and the specialized Leadership 3000 development process was key in socializing its purpose and placing it in the array of company
Throughout the program’s twenty year run, three or four participants were nominated each year. The four phases of Leadership 3000 were multifaceted data gathering, synthesized feedback, comprehensive planning, and focused follow-up (see Table 1). This model is similar to those of some other data-driven leadership development initiatives and serves to remind program leaders of best practices and to reinforce their use. Reviewing these practices and considering possible variations of them may prove catalytic to those currently engaged in the rapid development of senior executive talent.

**Multifaceted Data Gathering:** Wasylyshyn gathered data from participants’ full life histories, a battery of psychometric tools, and the company’s established set of leadership and behavior competencies. These data were combined to provide participants with deeper insights about their own motivations, aspirations, and behaviors, and about the quality of their interpersonal relationships, especially in leadership positions. By performing these interviews over twenty years the organization itself learned to consider leadership competencies and behaviors, as well as personal skills, in other facets of talent management such as recruitment and performance review. Many managers came to refer to this information as the “Rohm and Haas what (competencies) and how (behaviors) of leadership.”

The first feedback meeting was designed to integrate the core themes of participants’ life histories with their psychometric findings. Armed with increased self-awareness and deeper insights about their leadership, participants were then primed to absorb the organization’s data about them.

**Table 2 – Rohm and Haas Leadership Competencies and Behaviors**

<table>
<thead>
<tr>
<th>Leadership Competencies</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Outside-in Perspective</strong></td>
<td></td>
</tr>
<tr>
<td>• Market Aware &amp; Customer Driven</td>
<td></td>
</tr>
<tr>
<td>• Strategic Focus</td>
<td></td>
</tr>
<tr>
<td>• Global Perspective</td>
<td></td>
</tr>
<tr>
<td><strong>II. Speed to Market</strong></td>
<td></td>
</tr>
<tr>
<td>• Bias for Action</td>
<td></td>
</tr>
<tr>
<td>• Adaptive to Change</td>
<td></td>
</tr>
<tr>
<td>• Creative Problem Solving</td>
<td></td>
</tr>
<tr>
<td><strong>III. Pursuit of Profitable Growth</strong></td>
<td></td>
</tr>
<tr>
<td>• Professional Credibility</td>
<td></td>
</tr>
<tr>
<td>• Business Acumen</td>
<td></td>
</tr>
<tr>
<td>• Persuasion and Influence</td>
<td></td>
</tr>
<tr>
<td>• Safety Performance</td>
<td></td>
</tr>
<tr>
<td>• People and Performance Management</td>
<td></td>
</tr>
<tr>
<td>• Interpersonal Effectiveness</td>
<td></td>
</tr>
</tbody>
</table>

**Leadership Behaviors and Personal Competencies**

**Courageous Leadership** - relishes leading: willing to speak out, stand alone, influence open debate, probe unexpressed views, and leverage resident wisdom. The courage to confront any company sacred cows, decisions, policies, or practices that could interfere with success.

**Emotional Fortitude** - ability to use self-awareness, self-management (focus, discipline, tact and diplomacy), attunement (empathy), and relationship-building skills (relating to people in ways that are deeper than transactional need) to drive business success. Emotional resilience (the ability to cope with ambiguity, crises, and adversity in all forms). Stays cool under pressure.

**Enterprise Thinking** - playing for the house. Avoids silo mentality. Input into key decisions focused on overall company objectives. Will put personal comfort aside to take on difficult new roles or additional assignments. More focused on building a great company than on personal ambition.

**Pragmatic Optimism** - instills hope about the company’s future through consistent messages that emphasize the rightness of the strategic direction, specificity of objectives and realistic timelines, company values, and effectiveness of executive leaders.

**Steel Trap Accountability** - relentless drive for positive results. No defensiveness. No sad stories. No excuses. No blaming others. Making the necessary adjustments (in people, process, and/or strategy) as needed, and doing it quickly. Knows that hard work is not enough without results.

**Truth-Telling** - stating the business reality as it truly is compared to established goals. Consistent candor and early indication about the current reality of results, problems, projections, and performance issues. Behavioral transparency and authenticity.

human resource development activities.” Throughout the program’s twenty year run, three or four participants were nominated each year.

The four phases of Leadership 3000 were multifaceted data gathering, synthesized feedback,
integrate the core themes of participants’ life histories with their psychometric findings. Armed with increased self-awareness and deeper insights about their leadership, participants were then primed to absorb the organization’s data about them. The second feedback meeting focused on using the organization’s leadership and behavior data to identify the participants’ specific strengths as well as qualities they should strive to develop. The meetings rarely revealed any glaring deficiencies. Instead, they uncovered nuances of behavior and ability which are invaluable to business leaders with great potential. The focus on making best use of the participants strengths often yielded more developmental progress—and even breakthroughs. Many participants exhibited strengths such as: bias for action, strategic focus, business acumen, and courageous leadership.

The behavior which participants most frequently needed to develop further was emotional fortitude, which confirmed the importance of our focusing on the behavioral dimension of leadership, or what has become known as emotional intelligence. These qualities are composed of self-awareness, self-management, attunement to others, and the skills needed to build relationships. Several years after we commenced Leadership 3000, Daniel Goleman wrote, “To enhance emotional intelligence, organizations must refocus their training to include the limbic system. They must help people break old behavioral habits and establish new ones. That not only takes much more time than conventional training programs, it also requires an individualized approach.”13 Jack Welch concurred, writing some years later, “No doubt emotional intelligence is more rare than book smarts, but my experience says it is actually more important in the making of a leader. You just can’t ignore it.”14

**Comprehensive Action Planning:** After the two feedback meetings, Wasylyshyn collaborated with each participant to create a preliminary action plan (PAP) that provided the basis for an action planning meeting attended by the participant and members of their Leadership 3000 brain trust.15 In this meeting, the CEO and the participant’s boss described actions they felt had been central to their own evolution into senior business leaders, offering the participant meaningful, immediately applicable guidance for their ongoing success and future prospects. By integrating the fruits of this meeting into their PAP, participants then created a Master Action Plan (MAP) that included timelines for their progress. Wasylyshyn noted, “While MAPs could include familiar development vehicles such as business school executive education programs, job rotations, task force assignments, short-term mentoring, and executive coaching, they were especially distinguished by the pursuit of ‘lessons learned’ as provided by C-suite members.”16

**Focused Follow-up:** A year after the Leadership 3000 action planning meeting, the participant would once again meet with their brain trust for a focused follow-up discussion. By then, the participant had had sufficient time to work the MAP in their everyday life. In preparation for this meeting, Wasylyshyn, having spent time with the participant throughout the year, worked with the leader to annotate the original MAP. Their notes indicated both progress made and areas, either already identified or arising from the participant’s new responsibilities, in which further guidance was needed. Now having shifted from the role of executive coach to that of trusted leadership advisor to the majority of participants, Wasylyshyn continued to work with them on internalizing and applying the insights they’d gained.17

**Optional Spousal Module:** In keeping with the holistic intent of Leadership 3000, we designed a completely confidential and optional spousal module. More than 80 percent of the participants had partners who, along with their boss, colleagues, direct reports, and key business contacts, were major figures in the participants’ lives. We wanted to offer these couples a meaningful experience that might help to ease the pressures and concerns they felt and, by so doing, improve the participant’s ability to focus on and respond to business concerns. The participants’ partners were often both surprised and impressed that the company was attuned to the crucial role they played in the participants’ success. As one spouse said, “We had our tension like any married couple but not so bad that we’d go to therapy. Having this confidential opportunity to explore the work-related pressures and impact on our family helped us resolve some things in a constructive and problem-solving manner.”

---

As one spouse said, “We had our tension like any married couple but not so bad that we’d go to therapy. Having this confidential opportunity to explore the work-related pressures and impact on our family helped us resolve some things in a constructive and problem-solving manner.” Wasylyshyn facilitated this module by gathering data from each partner and meeting with both
to discuss the common themes that had arisen. These customized interviews focused on work/family integration issues including the stress of assignments abroad, repatriation, dual careers, and planning for retirement. About 10 percent of Leadership 3000 participants chose to use this optional module. Although this article does not explore why participation wasn’t higher, the topic of partner participation in top leader development certainly deserves further research.

Practice Considerations: Forging Meaningful and Sustainable Workplace Relationships

Leadership 3000 was built on the established talent management practices cited above. It also strove to build powerful relationships, particularly through three practice goals: continuity, a commitment to one process and one external partner, fierce truth-telling, and attunement, meeting with participants according to their needs and supporting their ongoing work with Wasylyshyn.

Leadership 3000 participants were frequently contacted by executive recruiters hoping to lure them away. Because of the safety and candor of their relationships with members of their Leadership 3000 brain trust, they could openly discuss the pros and cons of leaving the company. The result was that, in over twenty years, the company lost only two of its top leaders.

Fierce Truth-Telling: While the program held the guiding principle of data confidentiality sacrosanct, Wasylyshyn did use this information to identify participants’ strengths and weaknesses. This encouraged all members of each participant’s brain trust to be highly honest and transparent. This truthfulness gradually effected the company’s pervading culture as well, which surely would have pleased former CEO Larry Wilson. Wasylyshyn wrote, “It would appear that the fierce truth-telling that characterized this work also chipped away at a ‘Rohm and Haas polite’ dynamic...in the early days of the Dow acquisition (2009), Dow executives described Rohm and Haas top talent as ‘considerably more aggressive and direct’ as compared to their Dow peers.”

Attunement: Meeting participants where they needed to be met: Initially, broader logistical and scheduling issues made establishing and maintaining interaction with Leadership 3000 participants challenging. As employees came to perceive the program as a particular developmental advantage, however, the difficulty waned. The program’s pragmatic, step by step collaboration on both the preliminary and master action plans made the benefits more tangible. Participants were also strongly motivated by having the CEO or other C-level executives at the table to discuss their development plans and then to scrutinize their progress a year later. In other words, it mattered that this work had not been relegated to Human Resources. The participants benefited from greater exposure to senior management and individual attention to their specific development needs. Because of the program’s emphasis on relationships and a holistic, ‘we see you’ perspective, several participants also received support and assistance during difficult personal events. Wasylyshyn helped one participating couple to adjust to the news that one of their children was gay and arranged for another participant to work with a bilingual bereavement counselor after the sudden death of his father. While this article’s focus is elsewhere, it is clear that affiliative love, the strong bonds of friendship and mutual concern, played an important role in the Leadership 3000 program.

Conclusion

So why is Rohm and Haas considered one of the best “CEO universities” in the world? On the surface, we believe it is due to the...

Continuity: By committing to one psychologically-informed leadership development model and one external consultant, Rohm and Haas reaped several benefits including: preparing leaders faster for bigger roles, delineating a clear and sustained set of desired leadership competencies, devising a clear vocabulary of the behavioral norms for effective leadership, and the unexpected benefit of retaining top talent. Leadership 3000 participants were frequently contacted by executive recruiters hoping to lure them away. Because of the safety and candor of their relationships with members of their Leadership 3000 brain trust, they could openly discuss the pros and cons of leaving the company. The result was that, in over twenty years, the company lost only two of its top leaders.

Continuity: By committing to one psychologically-informed leadership development model and one external consultant, Rohm and Haas reaped several benefits including: preparing leaders faster for bigger roles, delineating a clear and sustained set of desired leadership competencies, devising a clear vocabulary of the behavioral norms for effective leadership, and the unexpected benefit of retaining top talent. Leadership 3000 participants were frequently contacted by executive recruiters hoping to lure them away. Because of the safety and candor of their relationships with members of their Leadership 3000 brain trust, they could openly discuss the pros and cons of leaving the company. The result was that, in over twenty years, the company lost only two of its top leaders.
company’s steadfast use of specific management practices and of a psychologically informed leadership development program which emphasized behavior to accelerate the careers of its high potential talent. Over 20 percent of Leadership 3000’s seventy participants went on to become CEOs elsewhere after the company was sold to Dow in 2009. While we have described these practices and the Leadership 3000 model, some critical questions remain: What were the key factors in the success of this work? Does the work have enduring aspects which could be useful in current leadership development initiatives? To answer these questions fully would require research into the value of running one leadership development model for many years, the impact of a CEO’s active participation in planning the development of high potential employees, and the role of psychological insight in leadership development initiatives.

For now, let us simply emphasize that the company’s twenty year commitment to Leadership 3000 was central to its success. Likewise, its basis a steady set of leadership competencies and essential leader behaviors was key. The active interactions of the CEO and other C-level executives with participants throughout, which we referred to as conveyance of wisdom, was critical as well.

On a deeper level, we believe the strength of this work was its philosophical commitment to what Feck described as the need to go “inside-out” with participants. We helped them to discover and apply fresh psychological insights about their own motivations, aspirations, and impact. Our holistic approach deepened their self-awareness. And by forming close relationships with them we increased their ability to internalize and apply what they had learned.

Through all of this, we wanted the participants to realize that we were trying to see the full complexity of their lives, not just their professional roles.

Through all of this, we wanted the participants to realize that we were trying to see the full complexity of their lives, not just their professional roles. We believe it was through this fundamental human need to be seen, to be heard, and to be understood that we engaged with these gifted people. We strove to honor them with the certainty that, in the totality of their lives, they could become even more. Is engaging with employees in this way still important now? Yes...more than ever.

Endnotes


2. After the company was sold to Dow, twelve of these leaders became CEOs of public companies. These include Pierre Brondeau (FMC), Guillermo Novo (Ashland), and Carol Eicher (Innocore). Another six assumed CEO responsibility for private or community entities.


5. Feck died in 2000 and Wasylyshyn had three subsequent CHRO partners in Leadership 3000.

6. When this program was initiated, the balance between work and family was not the prominent workplace consideration that it is now. This work legitimized it as an important issue and it became more aptly referred to as work-family integration.

7. Given the behavioral dimension of this leadership development challenge, Feck specifically wanted to include a consulting psychologist.


10. Wasylyshyn was trained as a clinical psychologist with an emphasis on the stages of human development based on Erik Erikson's theory of human development stages. The way a participant completed the psycho/social tasks of each development stage often had important implications on how they were handling their leadership roles.

11. The psychometric battery used for Leadership 3000 included the following: Myers-Briggs Type Indicator, Watson-Glaser Critical Thinking Appraisal, Life Styles Inventory 1, Revised NEO Personality Inventory (NEO PI-R), BarOn Emotional Quotient Inventory (EQI), Rorschach, Hermann Brain Dominance, Guilford-Zimmerman Temperament Survey, and PRF-Form E.

12. This emerged as a particular development need. Participants possessed significant innate capability and industry knowledge but were often less strong in terms of emotional intelligence (EQ). For many, Leadership 3000 provided the opportunity for them to integrate IQ and EQ in ways that intensified their overall effectiveness as leaders.


15. The Leadership 3000 brain trust of every participant consisted of his or her boss, the CEO or another C-suite executive, the corporate head of HR, and the external consultant. Since there was no end date placed on participants’ access to members of their development brain trust, participants could call on them for years thereafter, as well as through the four phases of the Leadership 3000 process.


18. The Leadership 3000 Spousal Module was created in 1990; if it were created now, it would be called the Partner Module.

19. Again, we use the more apt term “work-family integration” instead of the popular “work-family balance.” For top talent individuals, work-family balance—if viewed literally as an even division between work and family—is not a realistic objective.

20. During the twenty-one years of Leadership 3000, only two out of seventy participants left the company—one for personal reasons and one to take a senior post with a salary Rohm and Haas could not match.

21. Many of the Leadership 3000 participants worked in regions other than the U.S.
A MANAGER’S DILEMMA:
SOW OR HARVEST

Vijay Govindarajan, Ashish Sood, Anup Srivastava, Luminita Enache, and Barry Mishra have found that companies must focus relentlessly on building long-term competencies, even if doing so reduces immediate profits. Nonetheless, it is vital to shift focus when your product or idea becomes unexpectedly successful, so that you can milk that opportunity’s profits before it vanishes in the face of competition and technological progress.
Developing the dynamic capabilities that enable firms to accomplish both current and long-term objectives is neither easy nor cheap.

Firms routinely face a vital dilemma: whether to continue to reap the profits of existing competencies or invest in new competencies which might produce future profits but reduce current ones. PepsiCo has to find a balance between the continuing income of sugar-laden products and shifting to healthy drinks and snacks which accommodate changing consumer needs. Ford Motor Company has to choose whether to go on milking its established internal combustion vehicle brands or reinvent itself for the emerging markets of electric automobiles, ride sharing, and self-driving cars. Developing the dynamic capabilities that enable firms to accomplish both current and long-term objectives is neither easy nor cheap. Firms struggle to optimally divide their scarce resources between sowing and harvesting and, all too often, end up vacillating between the two.

Should managers shift their focus back and forth, and if so, when? We examine this question by observing how the investors react to their firm’s shifts in focus. Investors can read these shifts in the firm’s selling, general, and administrative (SG&A) expenditure which includes investments that improve future profits like strategy, brands, patents, innovation, customer relations, market intelligence, organizational technology, and human capital, as well as those that support current operations, such as product and sales support, sales commission, delivery costs, and advertising. These outlays, representing over a trillion dollars in the U.S. economy, can create both short- and long-term value.

Working from the assumption that stock market response is a good indicator of the long-term best interest of the firm, we examine the stock market’s reaction when firms shift their strategic focus from sowing to reaping, or vice versa, and the conditions under which market responses differ. From this scrutiny we have drawn five important insights.

1. Focus Relentlessly on Value Creation
Although the popular press frequently bemoans shareholders’ obsession with immediate profits at the cost of long-term value, we have found that stock markets react negatively when companies shift suddenly from sowing to harvesting. This response indicates that investors believe such unexpected changes in strategy to be detrimental to the firm’s interests. Indeed, they are quite willing to postpone their profits as long as the firm continues to focus on creating value. Anecdotal evidence supports this proposition. In the face of operational losses, shareholders continue to back Tesla, Uber, and Twitter, with double- or even triple-digit billion-dollar valuations, because such companies continue to build future value.

Firms which imprudently believe the common misperception that the stock market punishes firms with a long-term focus can wind up damaging profitable investment strategies. High-tech companies, such as those offering internet services, electronics, pharmaceuticals, and telecommunications, suffer the most from the market’s punishment of shifts towards a short-term focus. There are two possible reasons for the market’s particular disapproval. First, investors believe that continual innovation is essential to ensure long-term profitability. Second, and perhaps more important, investors also believe that, because the competition keeps innovating, investment is vital even to short-term survival. Recent research shows that, for technology companies, R&D is no longer a discretionary expenditure: it is a necessity of survival. LinkedIn, for example, continually upgrades its proprietary systems for feature extraction, information retrieval, and matching to improve member searches by strengthening its data sets. If it failed to improve constantly, it would lose its market share in no time.

Investors’ beliefs could also reflect current economic realities. Creative destruction moves ever faster in the corporate sector while the life cycles of products are becoming shorter. Consider, for example, how often most of us replace our mobile phones now, compared with the nearly endless lifespans of rotary phones. In recent years, companies that failed to innovate saw their market shares usurped with shocking rapidity, from Yahoo’s mail service and Alatavista’s search engine to Kodak’s films and cameras and Blackberry’s phone. And this phenomenon is not confined to technology companies; traditional businesses such as Macy’s, Borders, and Blockbuster have also suffered. Right now, decades-old health care giants like UnitedHealth Group Inc. are under attack from a joint venture by Amazon, Berkshire Hathaway Inc.,
and JP Morgan Chase. Nonetheless, rapidly changing technological and market conditions make it increasingly difficult to forecast which specific action will lead to success, like pinpointing the molecule that will become the next blockbuster drug or determining which app will be the most appealing in 5G.

2. When Opportunity Knocks, Grab It

Our second insight is that, by quickly shifting their focus from sowing to harvesting when opportunities arise, firms can maximize their returns. Shareholders reward firms which nimbly take advantage of a sudden success in product markets. Such opportunities come rarely and disappear quickly in today’s fast-moving world. In the biotechnology industry, only one in 5,000 projects reach the laboratory stage finds commercial success. Among thousands of social media startups, only a few manage to become Snapchat, Twitter, or Facebook. When a company’s idea or product strikes gold, it must immediately shift its efforts toward milking the profits from that lucky strike. After all, the company had been investing its precious resources in creating just such a scenario and it won’t be long before copycats and superior products arrive.

In the past, successful products required large investments in factories, warehouses, and supply chains. Today, high-technology and digital products can rapidly be marketed globally, thanks to technological production, marketing, and distribution that are faster than ever before. How much time or money does it take to produce one more copy of Microsoft Windows or deliver services to one more Facebook subscriber? Almost none. So firms get the most out of unexpected opportunities by changing their strategic focus rapidly, perhaps by immediately increasing production or poaching the best sales team from the competition so as to expand into new markets.

In short, when fortune strikes and a product succeeds unexpectedly, the firm must instantly shift to branding, positioning, producing, distributing, and securing markets for that product. This prescription may seem obvious but shifting from sowing value to harvesting value when the moment strikes is a surprisingly underused tactic. Technological entrepreneurs are generally eager to invest in innovation and are careful to hire the best scientific and product-development teams. Yet the same entrepreneurs frequently fail to appreciate the value of hiring the best marketing minds who are essential to branding, advertising, and positioning their products in the right market and at the right price, and to getting the greatest profit out of a new product. While Yahoo was the most visited site on the web for a long time, it could never figure out how to turn that traffic into money.

When opportunity knocks, top management must divert its attention toward earning profits.

One probable reason that small companies don’t tend to turn eagerly toward harvest is that, more and more commonly, their primary aim is to be purchased at a premium price by a larger company. They are less interested in growth, profits, and shareholder dividends. Google snapped up YouTube for $1.7 billion, Facebook acquired Instagram and WhatsApp for $1 billion and $19 billion, respectively, Walmart acquired Jet.com for $3.3 billion and FlipKart.com for $16 billion, Salesforce bought Tableau for $15.7 billion, and Microsoft acquired GitHub and LinkedIn for $7.5 billion and $26 billion. Most of these acquired companies had yet to show profits despite their established market leadership. Yet while earning profits may not be
the main goal of modern startups it remains the principal means of creating value for shareholders. So when opportunity knocks, top management must divert its attention toward earning profits.

In reaping the rewards of a successful product, managers must focus not only on creating its ideal market but also on securing that market.

3. Don’t Forget to Lock the Door Behind You When You Are Busy Harvesting Value

Right now, iPhone is facing a threat from Huawei. Despite having produced one of the most successful products ever and having a phenomenal strategy for exploiting that success, Apple left itself vulnerable, ignoring the price-conscious segment of the market. This is the fastest growing group in emerging economies such as China, India, and various African nations. In reaping the rewards of a successful product, managers must focus not only on creating its ideal market but also on securing that market. They must ensure that their product becomes the de facto industry standard, cultivating relationships up and down the value chain and establishing proprietary ecosystems and networks. By building these walls, they can increase the switching costs for locked-in customers and value-chain partners, delaying their fall from market leadership when competitors arrive. When Microsoft established its operating system, it was quick to create an implicit, exclusive partnership with Intel that kept cheaper and often superior alternatives at bay.

And firms must keep enhancing their products, as well as their ancillary features, while they promote them. By so doing they increase customer lock-in. Instagram and WhatsApp are both extensions that have strengthened, or at least maintained, Facebook’s grip on its customers. Attention to this area is particularly important when the market structure creates winner-take-all profits, leaving nothing for the runners up. Internet-based product markets can generally accommodate just one or a very few large leaders globally, and do not have the scope to accommodate a range of regional players coexisting peacefully in their own areas. For example, social media, a new market, is controlled by Facebook, while utilities, an old market, are distributed among numerous small regional players. Firms must be sure to encourage managers to defend market shares as well as, or even at the cost of, pursuing profits.

4. Communicate Regularly with Investors About the Firm’s Strategic Focus and Its Change.

Over time, effective communication with investors has become ever more important, both when the firm invests in ways that reduce immediate profits and when it shifts from sowing to harvesting. In 2019, Tesla CEO Elon Musk said: “It’s hard to be profitable with that level of growth…. We could slow it down, but then that would not be good for sustainability and the cause of electric vehicles.” This sort of communication is especially important since the rise of activist investors in the 1990s. While activist investors generally add value by subjecting corporate strategies to market-based checks and balances, they can also be disruptive when a firm fails to adequately explain its strategy. Without enough information, activist investors can force firms to curtail investments such as R&D, even though doing so destroys long-term value.

The market penalty for shifting suddenly from sowing to harvesting has decreased over time. Markets no longer perceive sudden changes in a firm’s strategic emphasis as negatively as they once did. Outside shareholders may be coming to realize that managers have access to private information which would damage the firm’s opportunities if it were revealed. Nonetheless, the penalties for unexpectedly reporting losses remain severe, so firms should be prepared to explain changes in strategy during calls with analysts or in the management, discussion, and analysis sections of their financial statements.

Whatever the reason, the optimal strategy differs by industry and context.

5. Determine the Best Strategy According to Your Industry and Circumstances

While providing clear general guidance, our study offers no one-size-fits-all prescription. High-technology industries suffer most from negative stock market reaction when they shift unexpectedly from sowing to harvesting. Yet, these same industries reap the greatest benefits from a well-timed change in strategy. By contrast, low-technology industries such as forestry, agriculture, and restaurants may see a positive market response when they realign from sowing to reaping, perhaps because investors do not expect huge payoffs from these diminishing industries and actually prefer to focus on immediate profits. Whatever the reason, the optimal strategy differs by industry and context.
Through this study we have revealed new insights which can guide firms on when to focus on sowing and when on harvesting as well as on the circumstances in which they should shift that focus.

Conclusion

Through this study we have revealed new insights which can guide firms on when to focus on sowing and when on harvesting as well as on the circumstances in which they should shift that focus. Managers can also adopt our measures on sowing, harvesting, and shifts in strategic focus to establish a more data-driven approach to developing new products, marketing, and investment strategies. Solid metrics enhance the power of analytics, optimizing their results by allowing firms to invest in creating value at appropriate times and to enjoy the higher returns that result from shrewd shifts in strategy.

Vijay Govindarajan is the Coxe Distinguished Professor at Dartmouth’s Tuck School of Business and Faculty Partner at the Silicon Valley incubator Mach 49. He is the author of The Three Box Solution. Govindarajan is one of the world’s leading experts on strategy and innovation and a two-time winner of the prestigious McKinsey Award for the best article published in the Harvard Business Review. vijay.govindarajan@tuck.dartmouth.edu

Ashish Sood is a professor of marketing at the University of California Riverside. He investigates innovation, technology management, emerging markets, and marketing strategy. His research has been published in prestigious journals including Marketing Science and the Journal of Marketing and has won numerous research awards and grants. ashish.sood@ucr.edu

Anup Srivastava holds the Canada Research Chair at Haskayne School of Business, University of Calgary. He is one of the foremost experts on valuation and financial reporting of intangible assets. He has published more than twenty practitioner-oriented articles in the Harvard Business Review as well as a range of scholarly publications in top academic journals. anup.srivastava@ucalgary.ca

Luminita Enache is an Assistant Professor at Haskayne School of Business, University of Calgary. She investigates the corporate governance and financial disclosures of new-economy firms as well as the measurement of intangible assets. Her research focuses on biotechnology firms. luminita.enache@ucalgary.ca

Barry Mishra is a Professor and Associate Dean for Graduate Programs at the School of Business at the University of California, Riverside. He is an expert in game theory, agency theory, and econometric methodology. He is also interested in entrepreneurship and is involved in the NSF I-Corps Startups for Innovators program. barrymi@ucr.edu

Endnotes

1. To divide SG&A expenses into sowing and harvesting outlays, we follow L. Enache and A. Srivastava (2017), “Should Intangible Investments Be Reported Separately or Commingled with Operating Expenses? New Evidence,” Management Science 64(7): 3446–3468. Further information on the technical details of our research methods may be found in an online Appendix (https://haskayne.ucalgary.ca/sites/default/files/Faculty/Online%20Appendix.pdf).
PURPOSEFUL LEADERS, POWERFUL IDEAS, POSITIVE IMPACT

Exceptional learning experiences for managers and executives, built on evidence-based ideas and a customer-centric approach to help you achieve your goals and succeed in an ever-changing world.

TOP 10 GLOBAL PROVIDER
- Financial Times, 2020

CONNECT WITH US:
rossexeced@umich.edu
michiganross.umich.edu/execed

LEARNING EXPERIENCES FOR INDIVIDUALS | ORGANIZATIONS | IN-PERSON | ONLINE
One of the biggest challenges facing organizations today is the need to be agile. To achieve this goal, leaders must seek a deeper understanding of the power of social interaction in furthering the flow of ideas, information, and insight. Michael Arena explains how building relational structures that foster 4D connections, discovery, development, diffusion, and disruption, can usher in the new, innovative ideas and concepts necessary to positively disrupt.
Organizations today vitally need to be agile in the face of digital disruption. According to a recent study, 87 percent of executives believe that digital technologies will disrupt their industry to either a great or moderate extent. Only 44 percent of these same executives believe that their companies are doing enough to prepare. This rift between concern and response is staggering.¹

Most organizations seem to be endlessly enmeshed in managing their day to day realities. They simply weren’t designed to be agile. Having grown up in a world in which operational efficiency was king, they were designed to manage, coordinate, and control activities. In organizations of this kind, new ideas that crop up are quickly stifled or pushed aside to keep the focus on operational urgencies. They have perfected short-term operations at the expense of long-term adaptation. The result is a suppressive environment in which the ideas vital to rapid digital change are never heard. But here’s the good news: even in the midst of this constraint there are conditions under which people are willing to speak up. They’ll do it when they truly trust the people they work with. When they have close, open relationships, people are more willing to share, debate, and develop their ideas.

In this era of disruption, it is social capital that allows organizations to adapt in real time.

Agility turns out to be more social than structural. When open debates are stifled, the company’s agility is too. In this era of disruption, it is social capital that allows organizations to adapt in real time. Leaders must therefore nurture an environment of trust and engagement, and within that environment, understand the power of social interactions over the flow of ideas, information, and insights.²

This is where adaptive space comes into play. Leaders can create, engage, and protect the space needed to nurture and sustain adaptability. Adaptive space can be thought of as the relational, emotional, and sometimes physical space necessary for people to freely explore, exchange, and debate ideas. It is achieved by opening the connections through which people, ideas, information, and resources flow and interact within an organization so as to enhance learning and agility. By creating the right structures, processes, and events (i.e., realignment, collaboration sessions, innovation exchanges, brokering events, team cohesion interventions, etc.) leaders ensure that new adaptive outcomes can emerge.³

By tapping into the power of network dynamics, adaptive space creates connections that allow people to discover, develop, and diffuse new ideas throughout an organization. In order to be agile, organizations need to deliberately scan, both inside and out, for the next big thing. They need to consider how to bring these ideas into the tangible world. Finally, they need to disseminate these new concepts throughout the organization, positively disrupting themselves to create a new normal. Adaptive space enables the connections necessary to provide opportunities for people, ideas, information, and resources to be exchanged between small entrepreneurial pockets and to emerge into new formal structures and solutions that drive greater operational success.

4D Connections of Adaptive Space

Unlike traditional organizations, whose innovation and growth rely predominantly on strategies based in human capital, those which use adaptive space are instead supported by social capital strategies. Human capital consists of the talent, experiences, and capabilities of individuals within an organization. Social capital is the competitive advantage created by the connections between those individuals.⁴ It consists of the relationships and interactions within the organization. So, while human capital is about what people know, social capital is about how people are positioned to make best use of their knowledge. Both are essential, yet organizations have historically overemphasized the former at the expense of the latter.

Adaptive space challenges us to see how the two models complement one another. Human capital provides the intellectual capacity or potential to drive change, while social capital positions this capacity so that it can be swiftly and effectively applied. By opening up adaptive space, organizations get the most from existing intellectual capacity, while also moving with speed. The velocity at which ideas flow into and through the firm increases, bringing greater agility in its wake.

Most organizations don’t suffer from a deficit of ideas or human potential. What they lack is open and deliberate connections. Organizational leaders must learn to encourage the flow of these ideas by attending to the social interactions in the company. They need to build relational structures that encourage the 4D connections of adaptive space: discovery, development, diffusion, and disruption. Together, these 4D connections generate the innovative ideas and concepts necessary for positive disruption.

Discovery Connections are the bridges that connect different groups, allowing organizations to overcome insularity. These bridges lead to ideas, insights, and information. Sociologist Ron Burt’s research suggests that the people best positioned to have insightful ideas are those who bridge the gaps between groups. In one study of nearly 700...
managers, he determined that the value of any given idea corresponded to the extent of the manager’s bridge connections. The more managers learned from other groups, the more valuable their ideas were.5

Adaptive space fosters the connections that trigger the novel ideas, new insights, and learning that lead to adaptation. Strictly partitioned silo structures inhibit this discovery process, limiting the flow of creativity. By deliberately encouraging interaction, managers open the path to novel ideas. Adaptive spaces encourage people to move beyond their own group and follow their innate curiosity. And brokerage is key.

Brokerage, in this case, refers to the bridging connections formed between groups when individuals act as links. In doing so, they provide a generative conduit for fresh ideas and information that increase their company’s ability to adapt. In the diagram below (Figure 1), the three people shown as yellow nodes were known idea people in a large consumer goods company. When a new perspective or a novel discovery was needed, these brokers could draw critical insights before the broader organization. The two brokers on either side of the diagram (4 o’clock and 10 o’clock) were the primary bridges to the field research teams (green clusters). They were formally assigned to interface with both a field research team and an operating team, acting as conduits carrying emerging insights into the broader operations group (blue nodes). The third broker (yellow node at 7 o’clock) interacted directly with retail centers and channeled back early insights into what succeeded in the market. Together, these bridge connections brought in a continuous flow of fresh ideas and information that kept the operations group agile.

These bridge connections need not always be formally designed. Another organization created the same effect by instituting open forum “pitch days” that allowed anyone in the firm ten minutes in which to present a transformative idea to a cross-functional panel of leaders. Participants whose ideas were selected were then encouraged to recruit a team of colleagues with diverse perspectives to continue the discovery process and flesh out the broader concept. Pitch days helped to create brokers and build the interactions that led to discovery.

Brokerage triggers new insights where existing groups intersect. These interactions ensure the diversity of thought and ideology essential to creative thinking. When everyone thinks the same way, there is no one to suggest alternatives. Brokerage connects the people, information, resources, and technology that generate novelty, innovation, learning, and growth.

These discovery interactions are the lifeblood of agility. Their fertile intersections bring forth innovative possibilities. Still, ideas are only useful when they are brought to life and applied.

Development Connections encourage the sharing and refinement of ideas within cohesive teams. Cohesive groups are composed of many redundant connections which often result in deeply trusting relationships. Members of these teams are therefore more willing to share openly, debating and refining their ideas. Harvard researcher Lee Fleming analyzed data on more than 35,000 inventors and found that, while bridge connections generate valuable ideas, they also hamper their application. For ideas to be useful, they need to be openly shared, experimented with, and refined. Fleming found that small, cohesive teams whose members trust each other are most successful at this stage.

Adaptive space encourages these development connections. Those who interact only within cohesive subgroups are less likely to come up with bold ideas, but are extremely proficient at developing those ideas. Development connections are critical because bold ideas become useful only by being socialized, developed, and applied. Small entrepreneurial groups tend to have higher cohesion between members which makes them powerful at elaborating and refining ideas.

Not only are cohesive groups ideal for developing, refining, and elaborating on novel ideas, they also

![Figure 1: Bridge Connections](image)
make it easier to scale those ideas up. Research reveals that the strong trust within these groups facilitates positive affect, learning, and risk taking—all crucial components of creativity and development. The resulting ideas are likely to be accepted and ultimately applied by the broader organization because they can readily be shared and because their small-scale application encourages early learning and continuous improvement through many iterations.

In 2016, General Motors acquired Cruise Automation, a driverless car start-up, in order to accelerate its own progress in that technology. Cruise still operates as an independent entity, housed in a warehouse-style office in San Francisco’s SoMa neighborhood. Inside, it looks like many other start-ups, a small band of twenty- and thirtysomethings in jeans, T-shirts, and hoodies, all with headphones on. If you look deeper, though, you will notice small, cohesive teams (represented by the colored clusters in Figure 2) of autonomous engineers, mapping technicians, software engineers, and data scientists, all working together to scrutinize data and flesh out the algorithms that lie behind Cruise’s self-driving capabilities. To advance the technology they must account for a complex interplay of sensory inputs including road patterns, driving techniques, map routes, lane positions, speed, cars, pedestrians, obstacles, and road surfaces. Each team (colored clusters) is devoted to perfecting its part of the algorithms necessary for safe self-driving capability. Cruise ensures this focus by dividing workers into these small teams. Between fierce focus and rapid iterations, these teams produced four technological generations in just under eighteen months.

Amazon calls these small clusters of development connections “two pizza teams” because they are small enough that two pizzas provide their lunch. Members feel more comfortable challenging one another’s ideas openly while still maintaining the trust that allows them to operate quickly. Their development connections spark ideas rapidly to life so that their impact is felt sooner. Still, even these well-developed ideas are of little value if they are stuffed away in some invisible pocket of a much broader organization. And that’s why diffusion is essential.

Diffusion Connections help to move ideas beyond their small development pockets by expanding them across the organization. Ideas developed deep within cohesive two pizza teams are 43 percent more likely to be rejected by other teams across the broader organization. This “not created here” backlash is what makes network energy essential.

In adaptive space interpersonal interactions distribute concepts from development throughout the broader organization. The value an enterprise reaps from enacting ideas in a small group is limited. Because they are isolated from other groups, cohesive subgroups often see their ideas dismissed by the broader organization. While these groups enact incremental changes effectively, they are less successful at promoting sweeping change. Members of a cohesive group may also be reluctant to risk their status within the network by pushing their ideas. Fortunately, diffusion connections carry ideas beyond their subgroup, allowing them to flow easily into the broader organization.

In high-energy networks ideas and concepts spread quickly through positive connections. Some years ago, a large medical devices company assembled a powerhouse innovation team of superstars in an effort to disrupt itself from within. Twenty-eight highly skilled individuals gathered daily to build new concepts and business models. They engaged those who used their devices in design thinking and prototype testing. After three years of work the team produced exactly zero commercial products. Management resigned itself to disbanding the group and redeploying the members throughout the organization. Then something remarkable happened. The very same concepts that the innovation team had suggested started to gain traction. It emerged that the team members hadn’t lost their conviction about reinventing the organization from within when the team dissolved. Instead they continued informally. Now they had broader access to the resources.
and promotional energy necessary to spread their ideas around. Soon the company had a bold new set of products to introduce to the market. Adaptive space helps to drive this kind of diffusion by engaging network energy.

Network experts Rob Cross and Wayne Baker conducted a comprehensive study of seven large organizational networks a few years ago. What they discovered was amazing: energy — particularly arising from a person they labeled an “energizer” — has a significant impact on organizational progress. They determined that energy from within a network creates a 4x lift in diffusing ideas. Energizers have a talent for actively engaging others in moving an idea forward. Their motivational power amplifies ideas throughout the organization. They have a unique ability to attract others to an initiative and convince them to act. People even seek out energizers when they need information. The energy they generate drives others to interact and devote discretionary time or resources to a given initiative.

When you combine the influence of energizers with bridge connections, the resulting diffusion is disproportionate. In one example a small cluster of individuals had early success with putting a new innovative practice in place but found their success limited to their own team. Then a single energizer (the small yellow dot in Figure 3) overcame the “not created here” impulse by attracting people from outside the group to the idea, rapidly dispersing the concept beyond its natal cluster. Using her position as a broker, this lone energizer activated 31 percent (the green dots in Figure 3) of a network nearly 600 strong simply through her ability to energize others.

Positioned as brokers, energizers create new possibilities by integrating different expertise or back-grounds. They inspire diffusion by enthusiastically encouraging others to engage with an idea. Nonetheless, these diffused ideas still need to shatter the brick walls of organizational structures and systems. And that’s where disruption connections are crucial.

Disruption Connections help to break down organizational roadblocks that stifle bold innovation. They disrupt the existing structures to make way for the formal endorsement of new solutions and innovations. Disruption connections enable the creative destruction that combats the status quo.

In traditional organizational structures and processes, formal leaders can inadvertently become roadblocks to new ideas and innovation. Adaptive space empowers the connections that can overcome the stifling effects of formal structures and build a network of support, spreading valuable ideas throughout an organization and ensuring that those with influence will hear about them. Formalization is the final phase in the 4D model, when new solutions are adopted into the company’s operational system. It can also be the hardest stage. In traditional organizational structures and processes, formal leaders can inadvertently become roadblocks to new ideas and innovation. Their role is to make strategic decisions about resource optimization which means they are inundated daily with ideas and suggestions, so it’s not surprising that they should be conservative. Because managers cannot approve all requests (or even all solid ideas), positive network buzz and fully developed concepts are critical in determining which ideas they choose to implement. To ensure that new ideas
are truly considered, it is therefore vital that workers challenge the existing structures.

Two financial service companies were in the midst of a major integration. The acquired company (represented as the blue cluster in Figure 4) was much smaller than its parent organization and was known for its entrepreneurial spirit. It operated as a tightly knit, familial team and encouraged its employees to participate actively. It had been tremendously successful with a series of innovative products that were quickly introduced to the market. In contrast, the larger parent company was a disciplined machine with a highly focused operational system. At first glance, the merger felt like a disaster to the smaller entrepreneurial company (see network diagram A. 4-months post-merger). However, when a handful of critical people from the acquired company were moved, it generated disruptive interactions which began to loosen the power structures of the parent company (see network diagram B. 7-months post-merger).

The resulting disruption connections modified the successes of the smaller company so that they could be considered as additional product lines by the parent company and then formalized into a vast distribution channel. An integration which initially seemed doomed to fail became a catalyst for a series of resounding market successes.

In order to be truly prepared to react to the digital disruption that surrounds them, organizations must more deliberately form disruption connections. These connections will need to overcome the natural tendency of groups to construct internal norms which make them resist disruptive thinking. By forcing interactions, as the two financial service companies did, organizations will loosen group thinking and pave the way for breakthroughs. Disruption connections pop social bubbles by continually introducing different perspectives, ultimately drawing focus to key influencers who can generate excitement about new possibilities.

In the face of the massive challenge that is digital disruption, organizations must be fluid, actively exploring, exchanging, and debating new ideas. Closing the enormous gap between the expectation that digital technologies will disrupt industries and the inability of companies to adequately respond depends on it. Together, discovery, development, diffusion, and disruption connections create a social construct that prepares individuals and organizations alike to disrupt before being disrupted.

Michael Arena is a faculty member in the University of Pennsylvania’s Masters in Organizational Dynamics program. He is also the author of Adaptive Space: How GM and Other Companies are Positively Disrupting Themselves. His research on adaptation won the 2017 Walker Prize from People + Strategy. He was nominated to the 2020 Thinker50 Radar list. In practice, Arena is the former Chief Talent Officer for General Motors and is currently the Vice President of Talent & Development for Amazon Web Services.
Endnotes


The COVID-19 pandemic has taught us lessons that can guide key decision makers in both the private and public sectors toward slowing climate change by reducing CO₂ emissions now. Howard Kunreuther and Paul Slovic explain how decision makers can design a risk management strategy that heeds the advice of experts and addresses the cognitive biases which obstruct effective action.
COVID-19 has dramatically revealed the difficulties society faces in dealing with extreme global events. As of August 7, 2020, in the United States alone, more than 5 million people have contracted the coronavirus and close to 160,000 have died from it. These numbers would have been much lower if public and private sector leaders had:

- Recognized the cognitive biases that obstruct effective decision-making and action
- Heeded the advice of experts
- Designed a risk management strategy that addressed cognitive biases and took the concerns of experts into account

We begin by examining why the United States did not use these strategies during the early stages of COVID-19 and why it imposed social distancing measures only after illness and death from the coronavirus ballooned in mid-March 2020. Using the lessons of the COVID-19 pandemic, we propose ways to implement a risk management strategy that would reduce the damage from climate change in the coming years by significantly reducing carbon emissions.

Decision makers are often guided by emotional reactions, cognitive biases, and simple rules of thumb rooted in personal experience. These processes are ill-suited for making choices about protective measures against extreme events of which people have limited or no experience. COVID-19: Cognitive Biases and Management Strategies

The Impact of Cognitive Biases

Over the last fifty years, a large body of cognitive psychology and behavioral economics research has revealed that decision makers are often guided by emotional reactions, cognitive biases, and simple rules of thumb rooted in personal experience. These processes are ill-suited to making choices about protective measures against extreme events of which people have limited or no experience. Cognitive biases and heuristics led both the public and leaders at national, state, and local levels to ignore the COVID-19 pandemic in its early stages, when it could most easily have been controlled.

Underestimating Exponential Growth

Foremost among the inherent biases is the failure to grasp the concept of exponential growth. William Wagenaar and his colleagues demonstrated this failure more than forty years ago with a series of pioneering psychological experiments. In one study, participants were shown a hypothetical index of air pollution beginning in 1970 with a value of three and rising yearly to seven, twenty, fifty-five and finally, in 1974, to 148. When asked to estimate the value of the index in 1979, many of the respondents gave answers at or below 10 percent of the correct figure of approximately 21,000 (as determined by the underlying equation). Subsequent experiments have revealed similarly dramatic underestimation of exponential growth and shown that participants typically base their erroneous judgments on the straight-line projections of early small increases.

The Washington Post conveyed the deceptive nature of exponential growth in a March 10, 2020 piece on the coronavirus pandemic. Megan McArdle presented a brain teaser about a pond on which the number of lily pads doubles each day. On the second day there are two lily pads, on the third day there are four, on the fourth day there are eight, and so on. If the pond is covered completely by the forty-eighth day, when was it covered halfway? The correct answer is forty-seven days. Almost everyone is surprised to learn that after forty days of exponential growth, you would barely notice the lily pads, as they would cover only 1/256th (0.4 percent) of the pond. It is therefore easy to ignore the steady exponential growth of lily pads for a long time—until they smother the pond.

One of the reasons that the general public and key decision makers largely ignored the coronavirus in January and February is that they failed to appreciate the looming menace of its exponential growth.

One of the reasons that the general public and key decision makers largely ignored the coronavirus in January and February is that they failed to appreciate the looming menace of its exponential growth. It is easy to visualize smooth, linear growth: one person gets the coronavirus today, another tomorrow, a third the next day, and so on, with the cases simply adding up over time. But most of us, including leaders and policymakers, find it difficult to comprehend exponential growth.

Figure 1a depicts the exponential growth of COVID-19 in the United
States from the first case, noted on January 21, through March 31, 2020. By February 29 only seventy people had tested positive for COVID-19. Yet by the end of March, 188,049 people had been diagnosed. Focusing on the period between January 21 and February 29 in Figure 1b, we can again see the exponential growth in COVID-19 infections.

We tend to underestimate the probability of a threat if we have not recently experienced a significant loss. Even when the threat becomes salient, we focus on its consequences rather than its likelihood.

Misperception of Risk
Another factor that delayed the U.S. response is the availability bias, in which we perceive the likelihood of an event occurring according to its salience and memorability. We tend to underestimate the probability of a threat if we have not recently experienced a significant loss. Even when the threat becomes salient, we focus on its consequences rather than its likelihood. Few people in the U.S. experienced severe illness from SARS or the H1N1 virus. As a result, the public was largely not worried about contracting the coronavirus in January and February 2020, when few illnesses were reported. Early comparisons to the seasonal flu also contributed to this complacency.

Only when the number of illnesses and fatalities skyrocketed in mid-March (as shown in Figure 1a) did Americans begin to focus on the effects that COVID-19 could have on them. They then perceived the risk of contracting the virus to be high because they dreaded its deadly potential and because it was a new risk. Psychometric studies in a number of countries have shown that these qualities strongly increase our fear of health and safety risks.

**Myopia, Optimism, and Herding**
When the general public and key decision makers chose to ignore the potential consequences of the coronavirus pandemic, several other biases played their part.

*Figure 1a and 1b. Exponential growth in the number of reported cases of COVID-19 in the United States*
If the country had begun imposing social distancing measures on March 1 rather than delaying for two weeks, an estimated 54,054 fewer people would have died by early May.

People tend to be myopic, failing to see the value of taking immediate action to reduce predicted severe future consequences. People are unduly optimistic about whether adverse events will occur, and we tend to follow the herd, allowing our choices to be influenced by other people’s behavior, especially when we feel uncertain. All of these reasons predisposed people to go about their normal social activities during the first two months of 2020 and to go on interacting with friends and co-workers during the early part of March. A study by researchers at Columbia University estimated that if the country had begun imposing social distancing measures on March 1 rather than delaying for two weeks, an estimated 54,054 fewer people would have died by early May.

Failure to Listen to Experts
Lulled by these cognitive biases, the general public and most decision makers at the national, state, and local levels in the United States were not concerned with COVID-19 during the first two months of 2020 nor did they give much thought to the possibility of a pandemic. Although 11,950 people in China had contracted the virus and 259 of them had died by January 31, few people in the U.S. felt alarmed. But epidemiologists did.

After scrutinizing its trajectory in China, epidemiologists understood that COVID-19 was a new and potent virus that was likely to spread globally. By mid-February they were urgently warning national leaders that the coronavirus was likely to infect and kill many people around the world. They knew that it would soon be classified as a pandemic and that it was important to take immediate steps to contain its spread. Yet government leaders in the U.S. failed to heed these warnings, making no effort to obtain sufficient test kits or determine who was infected during the early stages of the virus’s spread within the United States even though such measures would have allowed them to enact contact tracing and quarantine measures.

In early March, both the general public and business leaders continued their normal behavior because they had failed to appreciate the exponential spread of COVID-19. Americans across the country kept going to the office, meeting with friends, and shaking hands. By March 11, over 1,000 people in the United States had contracted the coronavirus, ten times more than in the previous week. On that same date, the World Health Organization declared COVID-19 a pandemic. Only then did the U.S. begin to recognize that steps would have to be taken to prevent a catastrophic increase in illness and fatalities from the coronavirus.

Designing a Risk Management Strategy for COVID-19
To effectively curtail the pandemic, epidemiologists advocated a risk management strategy comprised of three elements:

- Sufficient tests to locate those infected with COVID-19;
- Isolation or quarantine of those who had tested positive;
- Temporary closure of non-essential businesses and requiring citizens to shelter-in-place

Dealing with Climate Change
The same cognitive biases and failure to heed experts that exacerbated the coronavirus pandemic also drive our inaction in the face of looming catastrophes due to climate change.

The United States would have done well to emulate South Korea in enacting the above strategy. After COVID-19 emerged in China, the Korea Centers for Disease Control and Prevention (KCDC) quickly cooperated with diagnostic manufacturers to develop commercial test kits. The country soon had the broadest and best-organized testing program in the world, as well as extensive efforts to isolate infected people and to trace and quarantine their contacts. By mid-March, South Korea had tested more than 270,000 people—over 5,200 tests for every million residents in the country. At the same time, the U.S. performed only seventy-four tests per million residents according to data from the U.S. Centers for Disease Control and Prevention and the KCDC.

The same cognitive biases and failure to heed experts that exacerbated the coronavirus pandemic also drive our inaction in the face of looming catastrophes due to climate change.
Recognize the Impact of Cognitive Biases

According to a 2019 survey undertaken by the Yale Program on Climate Change Communication, a majority of Americans are now worried about climate change. Nonetheless, their concern does not drive most of the general public to take positive action because, although the perceived future consequences, such as extreme weather events, may be harmful, they are familiar and not perceived as controllable. Like the inattention that led us to ignore COVID-19 during the first two months of 2020, our inaction with respect to climate change is a product of our cognitive biases.

Relatively few homeowners, for example, have voluntarily invested in energy-saving technologies, often because of myopia. However, if homeowners focus on the future, they are likely to see that the expected long-term benefits exceed the upfront costs. In many areas of the country, the initial cost of adopting these measures is considerably less than the projected savings in energy costs over time.

People are also reluctant to alter their current behavior due to the inertia bias. This tendency is reinforced by the herding bias, in which people interact with friends and neighbors who feel as they do, and by the prominence effect, in which they are unwilling to give up existing comforts and conveniences like their accustomed level of heating and air conditioning.

Our failure to adequately address climate change is also a result of the way we process information: statistical data characterizing future risks do not evoke feelings of concern. Instead we experience psychic numbing, in which numerical projections of CO\textsubscript{2} concentrations fail to stimulate the emotional reactions necessary to motivate action. Our lack of concern is exacerbated by pseudoinefficacy, which makes us feel that any personal contributions we make towards reducing a catastrophic threat will be insignificant and thus ineffective.

As with COVID-19, it is important that political leaders and decision makers in the private and public sectors recognize these cognitive biases and turn to experts for advice on climate change.

Listen to Experts

As with COVID-19, it is important that political leaders and decision makers in the private and public sectors recognize these cognitive biases and turn to experts for advice on climate change. Climate scientists have long recognized that CO\textsubscript{2} emissions and their effects are increasing exponentially. Figure 2 shows the monthly average CO\textsubscript{2} concentration at Mauna Loa Observatory in Hawaii—the longest record of direct measurements of CO\textsubscript{2} in the atmosphere. The volume of CO\textsubscript{2} was 315 parts per million (ppm) in 1958, when it was first measured; by the end of February 2020, it had risen by 31 percent to 414 ppm.

This exponential increase indicates that CO\textsubscript{2} emissions and concentrations will be considerably higher in the coming years unless we take strong measures now to reduce them. If we do not, our climate will be driven to extremes that look nothing like a linear extrapolation of recent history. We will suffer blistering heat waves, severe droughts, accelerating rise in sea levels, unprecedented rainstorms and flooding.
Consider the damage that climate change-related flooding, combined with population growth in hazard-prone areas, could cause. A 2013 analysis of 136 major coastal cities around the world revealed that sea level rise (SLR) of an optimistic 20 cm (7.9 inches) by 2050 will cause the average annual flood losses in those cities to increase to $1.2 trillion in that year, compared to $52 billion in 2005. A more pessimistic scenario in which SLR reaches 40 cm (15.7 inches) by 2050 would bring average annual flood losses of $1.6 trillion. Houston was among the twenty most vulnerable coastal cities in the study. Its average annual damage according to the optimistic scenario would increase by 78 percent, from $5.1 billion in 2005 to $9.1 billion in 2050.\(^{18}\)

And people are actually moving into harm’s way, not considering the severe damage climate change might inflict upon them in the coming years. From 1980 to 2018, the population of Florida’s hurricane-prone counties increased by 163 percent from 3.7 million people to 9.8 million. The population of the United States as a whole rose by only 61 percent during the same period. These Florida residents seem oblivious to the fact that climate change will probably cause them to suffer the damage from increasingly intense hurricanes coupled with rising sea levels.\(^{19}\)

If \(\text{CO}_2\) emissions continue to grow exponentially, most of the United States could see twenty to thirty more days each year with maximum temperatures above 90 degrees Fahrenheit, and the Southeast could see forty to fifty more such days.\(^{20}\) Such extreme heat poses serious health risks, especially for the very young and the very old as well as construction and agricultural workers, and those living in urban cores. A study by researchers at the Earth Institute of Columbia University has found that, over the next forty years, the rising temperatures associated with climate change could cause wildfires in California to continue to grow exponentially.\(^{21}\)

The 2015 Paris Agreement, signed by nearly every country in the world, requested that the scientists at the Intergovernmental Panel on Climate Change (IPCC) produce a comprehensive analysis of the effects on humanity if global warming were to reach 1.5°C. The panel produced the 2017 Fourth National Climate Assessment, based on a plethora of peer-reviewed studies. Its primary finding was that \(\text{CO}_2\) emissions are already causing severe economic damage and must be significantly reduced immediately if we are to avoid even more serious losses.\(^{22}\)

In October 2018, the IPCC published a special report highlighting the importance of limiting global warming to 1.5°C above the preindustrial (1850-1900) average temperature relative to a 2°C increase, and describing the resulting benefits to people and ecosystems. The report indicates that to limit global warming to 1.5°C would require humans to reduce their \(\text{CO}_2\) emissions from 2010 levels by about 45 percent by 2030, reaching net-zero around 2050. If we are to achieve these objectives we must enact rapid and far-reaching transitions in land, energy, industry, buildings, transport, and cities. A follow-up to the IPCC report by Climainfo detailed some of the measures we will need to undertake.\(^{23}\)

A Risk Management Strategy for Climate Change
If we are to design a strategy to combat climate change, we must recognize that cognitive biases render both the general public and key decision makers hesitant to act to reduce \(\text{CO}_2\) emissions or invest in adaptations against future disasters. Concerns about reelection make political leaders reluctant to support legislation or global accords like the 2015 Paris Agreement if their constituencies do not seem concerned with climate change. By calling attention to the severe effects that might otherwise occur, the coronavirus pandemic represents an opportunity to encourage leaders to implement \(\text{CO}_2\) reducing measures now. A risk management strategy offers ways to address this challenge.

Our delayed and costly response to the coronavirus pandemic may have a silver lining: forcing us to recognize that we can no longer delay aggressive action to halt and reverse the more severe climate-related crises to come.

Learning from Experience
Our delayed and costly response to the coronavirus pandemic may have a silver lining in forcing us to recognize that we can no longer delay aggressive action to halt and reverse the more severe climate-related crises to come. Some parts of the world have already reached a tipping point, with residents of island nations all too aware that they will have to migrate elsewhere to escape rising sea levels. Given our susceptibility to cognitive biases and misperceptions, as well as our difficulty in dealing with climate change voluntarily, we must develop a risk management strategy which is economically attractive and includes well-enforced regulations at the state and national level.\(^{24}\)
**Short-Term Economic Incentives with Well-Enforced Regulations**

Consider the reluctance of many homeowners to incur the high initial cost of new energy technologies that reduce carbon emissions. Suppose it costs $15,000 to install solar panels, yet those panels reduce the household’s average annual energy bill by $3,000. With an annual discount rate of 5 percent or less, the expected savings would exceed the cost in only six years.\(^{25}\)

As of January 1, 2020, California has highlighted solar energy’s long-term economic benefits by requiring that all new single and multifamily residences be constructed with solar panels. The California Energy Commission, which approved the new regulation, estimates that the monthly mortgage payment on a house will increase by $40 a month but that the owner will save an average $80 a month on electricity.\(^{26}\) Because the cost of the solar panels is included in the mortgage, the owner’s costs are effectively lowered from the moment they purchase the house. This policy addresses the myopia bias by spreading the cost of solar panels over time, while reducing buyers’ budgetary concerns about the financial impact of a new house with solar panels.

At least fifteen states and Puerto Rico have enacted legislation requiring the reduction of greenhouse gas (GHG) emissions. Even more now require agencies to report or inventory GHG emissions. Several have also implemented carbon pricing policies, either independently or through regional agreements. California has a multi-sector GHG cap-and-trade program, while several Northeast and mid-Atlantic states participate in the Regional Greenhouse Gas Initiative, the first binding cap-and-trade program aimed at reducing GHG emissions from the power sector. Many of these same states are also part of the Transportation and Climate Initiative, committed to developing a cap-and-invest program intended to reduce transportation sector emissions.\(^{27}\)

One of the most effective ways of encouraging firms to reduce CO\(_2\) emissions is through carbon taxes on the production, distribution, or use of fossil fuels based on how much carbon their combustion emits. By setting a price per ton on carbon, the government is effectively taxing electricity, natural gas, and oil. So far, only two states—Washington and Maine—have considered referenda for such a tax, though public support was insufficient.\(^{28}\) The challenge for national and state leaders is to design and enact tax programs that will significantly reduce carbon emissions over the coming years.

**Construct Climate Change Scenarios**

One way to change people’s behavior in concert with economic incentives and regulatory pressures is to present detailed scenarios showing how future catastrophic events could affect their communities. Once they understand the danger, demonstrate that the likelihood and consequences of these disasters could be ameliorated by reducing carbon emissions. Visual images of rising sea levels in Miami or New Orleans or a range of other coastal areas and island nations tend to provoke emotional concern which drives people to support immediate action to reduce CO\(_2\) emissions.

Receptiveness to change is highest after a hurricane, flood, wildfire, or heat wave which causes deaths or severe property damage and interrupts business. The availability bias can then lead people to think about global warming during heat waves, wildfires, and severe storms. As these disasters increase, political leaders may pay closer attention and pass state and federal legislation to reduce carbon emissions.

**Business leaders can learn from the challenges of the coronavirus pandemic and plan now for the long-term consequences of climate change.**

Business leaders can learn from the challenges of the coronavirus pandemic and plan now for the long-term consequences of climate change.\(^{29}\) These leaders would do well to consider some basic guidelines:

- Reflect on decisions that the firm has made and how they could be improved and applied in creative ways.
- Consider the long-term benefits of various alternatives before deciding on a plan of action.
- Recognize that well-enforced regulations may be needed.

**Conclusion**

Right now, everyone’s top priority is dealing with the health and economic impacts of COVID-19. But the pandemic’s lessons will help us when our attention returns to the serious problem of climate change. Our cognitive biases and failure to appreciate the exponential process by which CO\(_2\) emissions increase make the catastrophic consequences of climate change seem distant and unreal. Yet, they will arrive far sooner than we expect.

If we are to effectively manage this dire global threat, cooperation between scientists (including behavioral experts) and leaders from government and industry is essential. Only then may we succeed in mitigating the consequences of climate change before it is too late.
Our thanks to Quinlyn Spellmeyer for her research assistance and to Carol Heller, Molly Haight, and the reviewers for helpful comments on earlier drafts of the paper. We gratefully acknowledge support from the Alfred P. Sloan Foundation under Grant G-2018-11100 and the Travelers/Wharton Partnership for Risk Management and Leadership at the Wharton School of the University of Pennsylvania.

Howard Kunreuther is co-director of the Wharton Risk Management and Decision Processes Center at the University of Pennsylvania. He is co-author with Michael Useem of Mastering Catastrophic Risk: How Companies Are Coping with Disruption. kunreuth@wharton.upenn.edu

Paul Slovic is president of Decision Research and a professor of psychology at the University of Oregon. He is the author of The Perception of Risk. pslovic@uoregon.edu

Endnotes

17. NOAA ESRL Global Monitoring Division
29. For more details on how business leaders and companies can deal more effectively with the adverse risks they face see: Kunreuther, H. and M. Useem (2020) Mastering Catastrophic Risk: How Companies are Coping with Disruption (paperback edition) New York: Oxford University Press.
HOW ORGANIZATIONS CAN ANTICIPATE THREATS, SPOT OPPORTUNITIES, AND ACT FASTER WHEN THE TIME IS RIGHT; WITH RICH EXAMPLES INCLUDING ADOBE, MASTERCARD, AND AMAZON.

“This is a thoroughly tested playbook for all leadership teams needing to think ahead and act strategically in the face of daunting uncertainty. The tools and frameworks that Day and Schoemaker provide will be sturdy handrails to use for the early detection, interpretation and timely response to weak signals of potential opportunities and impending threats.”

— VIJAY GOVINDARAJAN, TUCK SCHOOL OF BUSINESS, DARTMOUTH COLLEGE

“Day and Schoemaker offer a great roadmap for leaders wishing to hone their dynamic capabilities, drawing on best practices as well as the latest research from multiple academic disciplines. Their vigilance model has been tested with field data, practical wisdom and analytical modeling in line with current advances in building foresight. The book is also a terrific read.”

— DAVID J. TEECE, HAAS SCHOOL OF BUSINESS, UNIVERSITY OF CALIFORNIA, BERKELEY

mitpress.mit.edu
Boards of directors can play a critical role in determining how much attention their firms pay to sustainability. Craig Smith and Ron Soonieus explain how boards can turn their aspirations for sustainability into meaningful action, particularly in light of the fundamental questions boards should be asking in the wake of the COVID-19 pandemic.
Boards and Sustainability: From Aspirations to Action

Champions of sustainability have long recognized the importance of ‘getting the board on board’ with sustainable business practices. Boston Consulting Group conducted a large-scale study which identified board action as one of eight key factors in increasing the attention businesses pay to sustainability. Conversely, Paul Polman, former CEO of Unilever and principal architect of the Unilever Sustainable Living Plan, described the failure to make sustainability a board priority as one of the six major obstacles to corporate action. The utility of board engagement in producing tangible results, socially or environmentally, has long been acknowledged by both sustainability groups, like the UN Global Compact, and corporate governance groups, like the National Association of Corporate Directors. Both reason that action is part of the fiduciary duty of board members to increase their firm’s long-term value and mitigate its risks. They also argue that it is the responsibility of business to help address the urgent sustainability issues confronting humankind.

Simply put, an issue which is not on the board’s agenda is unlikely to be at the heart of the organization’s strategy. Yet surveys suggest that only a few boards give sustainability sufficient attention. A 2018 Ceres report on the progress of 600 large, publicly-traded U.S. companies found that only 31 percent had formally integrated sustainability into the board committee charters. So why aren’t boards more engaged with sustainability? The obstacles include misunderstandings of the fiduciary duty of directors; short term thinking, sometimes coupled with a focus on maximizing shareholder value; a belief that investors do not care; uncertainty about sustainability’s financial implications; and a dearth of expertise.

Yet a recent Board Agenda and Mazars survey, titled Board Leadership in Corporate Sustainability and developed in association with the INSEAD Corporate Governance Centre, is more encouraging. It suggests that, while board members are increasingly conscious of the need to incorporate sustainability into their broader business practice, they struggle to acquire the information, expertise, and processes that will allow them to deliver on their commitments.

Nonetheless, as companies struggle with the COVID-19 pandemic, some analysts predict that they are more likely to put aside sustainability in order to focus on pressing financial concerns. While contradicting the common emphasis on taking a long term view, this change would exacerbate lack of board engagement on sustainability.

What are boards really saying about sustainability? What are the obstacles to more effective action? What changes should be made by boards to respond more effectively to sustainability challenges?

Using the Board Agenda findings, our own interviews with twenty-five non-executive board members, and related research, we have explored how sustainability is being addressed in the boardroom. Our study examines three key questions: What are boards really saying about sustainability? What are the obstacles to their taking more effective action? What changes should be made by boards so that their companies respond more effectively to sustainability challenges?

Board Engagement Requires More Than Good Intentions

According to the Board Agenda survey, many board members believe their companies cannot succeed in the long term without supporting the communities they work in and the natural environment they depend on.

Of 234 surveyed business leaders—chief executive officers, chief finance officers, board chairs, executive and non-executive directors, company secretaries and sustainability officers—at companies of various sizes:

- 73 percent felt that ignoring sustainability will affect their company’s ability to create long-term value;
- 53 percent said their board sees a solid business case for sustainability;
- 29 percent indicated that their organisations aim to be positioned as market leaders in sustainability and to use it for competitive advantage, while a further 30 percent aim to keep up with developments and be seen as strong performers.

Only half strongly agreed or agreed that their companies had in place information and measures which allowed them to accurately quantify their company’s position, ambitions, and progress with regard to sustainability.

However, these beliefs and aspirations did not necessarily extend to their firms identifying the policies which need to be in place and the information required to meet environmental and societal challenges.
Only 53 percent of respondents said that their companies’ sustainability principles and intentions had been translated into effective business policies. Similarly, only half strongly agreed or agreed that their companies had in place information and measures which allowed them to accurately quantify their company’s position, ambitions, and progress with regard to sustainability. While respondents exhibited some understanding of the risks and opportunities of sustainability, their responses overall suggest that boards are just beginning to recognize its complexities and the difficulties companies face in gauging and integrating sustainability measures.

Survey responses also revealed that board members had limited sustainability knowledge or expertise:

- Only a third of respondents strongly agreed or agreed that their company required sustainability expertise or mindset in appointing non-executive board members or recruiting executives who are members of the board;
- Less than 30 percent of companies have a head of sustainability who reports directly to either the board or the CEO (and more than half represented firms that did not have a head of sustainability);
- Only 17 percent reported that their boards have a dedicated sustainability committee.

To better understand the attitudes of directors toward sustainability and how often and deeply they discussed the topic during board meetings, we conducted in-depth semi-structured interviews with twenty-five experienced European non-executive directors representing fifty well-known companies. In return for anonymity, our participants responded frankly, granting us rich insights into the engagement of boards with sustainability.

**Five Archetypes of Board Sustainability Behaviour**

We distilled our analysis of the interviews to reveal five distinct behavioral archetypes of board members. Although these profiles are stereotype simplifications of individual behavior, they help to explain why the attitudes of board members may diverge and why sustainability issues may be buried.

While the interviews did reveal that directors tend to gravitate towards companies with like-minded board members—birds of a feather flocking together—many nonetheless found that they had very different ideas from their colleagues on how sustainability should fit with business principles and strategy. One participant had been elected to the board by employees, rather than directors, specifically to speak on environmental issues. She found herself facing an uphill struggle with the other board members. “Having the board take sustainability seriously has been a long and lonely battle,” she reported.

We offer suggestions on how sustainability might be tackled where boards are predominantly characterized by a particular archetype as well as some broader recommendations for turning sustainability aspirations into effective action.

### 1. The Denier

We define deniers as those who see sustainability as nothing more than a buzzword or a fad that will fade away in time. In companies whose boards are dominated by deniers, sustainability is typically (at most) a page in the annual report. As one respondent put it, “If it does get onto the board’s agenda, it’s item number thirty-eight.” Because open hostility to sustainability is largely unacceptable today, these members aren’t always obvious. On their boards, environmental and social issues are conspicuous only by their absence. “In the five boards I’m on, it’s almost never discussed,” one director said, adding, “although most have a section in the annual report.”

“In my experience, sustainability in the short run is about value destruction,” another denier told us. A third described his company’s attitude toward sustainability as ‘the technocratic approach,’ admitting, “We are listed much higher on the Dow Jones Sustainability Index (DJSI) than we think we should be. Apparently, we have become very skilled in filling-out their 300-page questionnaire.”

As well as causing firms to overlook long-term risks, this approach is dangerous because it can so easily lead to greenwashing – the use of PR, marketing, or corporate communications to exaggerate the environmental benefits, or understate the environmental damage, of a company’s products and services. Volkswagen’s “clean diesel” advertising campaign, which ran while its vehicles were emitting up to 40 times the permitted levels of pollutants, is a salutary example.

### Eroding Denial

Whether on a board largely composed of deniers or merely reporting to them, our (non-denier) interviewees argued the necessity of meeting them on their own terms. Approach sustainability, indirectly if necessary, through specific, concrete concepts like cost-reduction, business opportunities, consumer demand, or risk exposure, rather than arguing abstract notions about the wellbeing of the planet or future generations.

Choose your moment with care, being careful not to raise the issue in times of crisis. “That’s when companies resort to alpha-male behavior to fix things,” said one interviewee. Another advised, “Never address these things at the end of the meeting, out of the blue.”
“What drives your resistance to sustainability?”

Patience is essential. Our small sample of largely sympathetic directors agreed that one-to-one conversations about sustainability were preferable to broaching the subject with the whole board. Once you have established an amicable relationship, you may be able to bring denial out into the open. After a series of patient, rational discussions with colleagues, one participant recalled reaching the point where he could directly ask fellow directors: “What drives your resistance to sustainability?”

2. The Hardhead

Unlike deniers, hardheaded board members are ready to talk about sustainability—and in positive terms. They regard it as a factor affecting their business. But because it is only one factor among many, they tend to reduce it to strategic reasoning. How can the costs be minimized? Are there any market opportunities? If so, how can they be maximized? As one participant put it, “We do what we can, but our business is still gas.”

Indeed, hardheaded board members are particularly prevalent on what might be called the dark side of sustainability. Oil and gas companies, transport operators, and agrochemical giants all take a surprisingly keen interest in the environmental and human impact of their operations, as do businesses for which health and safety are a major concern.

Our interviewees voiced several common hardhead objections to sustainability proposals:

- Society is demanding solutions, but it’s not giving up our products and services;
- The end-user is not as demanding as people like to think;
- “Recyclable plastic technology is available but is very costly;
- “Who are we to say that rainforests are rainforests, when the prosperity of the local people comes from palm oil?”

It can be difficult to counter such arguments and to see their logical flaws.

Redirecting Hardheadedness

Again, it is best to confront hardheaded board members on their own terms, urging them to make their company “best in class” or to “choose a more ethically acceptable route that’s not too far from existing practice,” as two of our interviewees suggested. “We will never be green,” said one hardhead we interviewed, “We focus on the issues we can really influence.”

If your company faces a diversity of issues, you might suggest appointing a dedicated sustainability director or non-executive directors from other industries, citing the need for diversity of thought to strengthen your argument. One board member reminded us, “Sector knowledge is important for two-thirds of your board. But one-third should think differently.”

“Consider making sustainability part of the risk or strategy committee to give it more ‘skin in the game’”

Hardheaded board members are nothing if not reasonable, so start with suggestions that will yield tangible results. From there, you can move on to matters which are not less important, but may be harder to grasp, such as longer-term risk.

“The board started to get an interest in the environment, when it started to raise these issues from a strategic risk perspective,” one director noted. “Consider making sustainability part of the risk or strategy committee to give it more ‘skin in the game,’” another advised.

Sustainability is relevant to a range of existing board committees: Corporate Governance, Audit, Compensation, and Nominating Committees. Nonetheless, it must also receive some attention from the entire board.

And be ready to concede when you are beaten. As one interviewee said: “If the CEO is not interested, it’s tantamount to flogging a dead horse.” Giving ground temporarily isn’t the same as giving up entirely. Keep track of the situation and the characters in it. You will soon learn to distinguish alpha-male deniers looking for a quick fix from ever-reasonable hardheads. Develop antennae to sense future disruption, risk, and alternative technologies that will strengthen your sustainability arguments in the board meetings yet to come.

3. The Superficial

The superficial archetype are decent folk who truly want to do their bit for society and the environment. But it’s important to remember where the old saying places good intentions. Directors of this type may be well-meaning, but they are often afraid to take the lead. They may be more concerned with being seen to do the right thing than with actually doing it. As a result, their positive influence is often less than that of hardheaded directors. As one interviewee said, “The boards I’m on don’t have a lot of interest in sustainability. They don’t see it as a differentiator. But most want to be decent, nothing more, nothing less.”

Superficial directors often have a shallow understanding of the need for sustainability. “The outside world is demanding CSR (corporate social responsibility) and sustainability reports or officers,” said one director. “That’s why we create them, not
because we see a business benefit in doing so.” Their conversations about sustainability go around in circles, rather than moving forward. Superficial boards tend to pass the buck, rather than taking action.

The worst among this type of boards implicitly promote greenwashing. By talking the talk, they encourage executives to do the same but fail to build the strategic framework executives and managers need to take real action.

Turning Good Intentions into Good Results
The trick with superficial board members, according to our participants, is to play on their good intentions rather than dwelling on past failures or decisions. They often don’t know where to start, so they’re likely to accept carefully chosen positive suggestions. Focus on issues that relate directly to the organization’s mission. A state-owned bank, for example, has a duty to serve the wider population, not just its own customers and executives. One respondent succeeded by regularly reminding fellow directors: “We can’t put ourselves on the wrong side of the fence.”

When their desire to do good is genuine, superficial directors are prime candidates for a dedicated sustainability committee. There, they find a safe, transitional space, where the company’s most active advocates of sustainability can comfortably talk through the issues and devise concrete actions for the whole board to ratify.

4. The Complacent
Early adopters of CSR reports, green products, and responsible supply chains often have not kept up with the latest thinking on sustainability. Not wanting to disrupt the deeply ingrained habits of their business, directors in this group are often reluctant to talk about sustainability. They may use past sustainability triumphs to shut the conversation down. Complacent board members invariably let good practice obstruct best practice, often causing the board to do even less than a superficial board.

Rousing the Complacent
Most importantly, one director told us, “Don’t embarrass people, policy, and decisions of the past 20 years.” When speaking with complacent directors, focus on small actions, rather than proposing a wholesale strategic review. In recruiting a new CEO, for example, try to include sustainability credentials among the recruitment criteria. Rather than rehashing the past, focus on calling attention to current consequences and errors, like greenwashing, as they arise.

Form coalitions with like-minded directors. Try to move the debate away from past work and into the present, urging the board to regain some of its old spirit and its members to become true believers once more.

5. The True Believers
These directors are not defined by the strength of their belief, but by their understanding of sustainability. True believers, like former Unilever CEO Paul Polman, link the long-term economic viability of their organizations inextricably to social and environmental responsibility.

As one participant from a board of true believers put it:

“Sustainability is no longer only about the environment, no longer a tick-box exercise. It has developed into a more holistic and broader view that you could call long-term value creation. The question is always: Are our products and business models future-proof?”

Another said, “Sustainability is not a goal on its own but rather a framework that guides strategy execution and the creation of long-term value.”

Challenges with True Believers
Yet true believers are also not without their challenges; they all too readily become their own worst enemies. Our interviewees pointed out that true believers need to be encouraged to carefully consider how best to engage with those who have not prioritized sustainability to the same extent. They may also risk becoming overinvolved in sustainability and neglecting economic constraints, albeit from a long-term perspective.
Businesses of any kind can keep sustainability on the board’s agenda and ensure that directors not only initiate sustainable practices, as required, but also demonstrate, to employees, investors, customers, and other stakeholders, how today’s actions can affect the profitability and future of the business and the planet.

Just how this is incorporated into the firm’s core products, business model, and innovation strategy, are all considerations which demand the attention, drive, and decision-making of a well-informed board.

**COVID-19 Changed Nothing (and Everything)**

Many have been quick to conclude that, in the wake of the COVID-19 pandemic, the priority will be the economic recovery of individual companies and whole economies, and that sustainability will have to take a back seat. However, other voices suggest that the pandemic could, instead, increase our attention to sustainability, and especially climate change.

Our ongoing work has revealed a similarly polarized perspective on the crisis in corporate boards. Perhaps crisis really does reveal a person’s true identity, or a board member’s true archetype. One director told us “we are fighting to survive; sustainability is not on our priority list,” while another said “COVID-19 shows us that ESG considerations are increasingly material to our ability to create value sustainably. It makes it very clear that in order to become more resilient we have to take a much more holistic view on our place in the world and the risks we are facing.”

According to Klaus Schwab, founder and Executive Chairman of the World Economic Forum: “The COVID-19 pandemic and resulting humanitarian and economic crisis have reminded us that firms are themselves stakeholders in the sense that they have an intrinsic interest in and shared responsibility for the resilience and vitality of the economic, social, and environmental systems in which they operate.”

And businesses have leapt to help in many ways, adapting production lines to make desperately needed protective clothing and...
ventilators. Struggling businesses have received assistance from governments, while public pressure to attach ‘build-back-better’ conditions to that money increases daily.

Indeed COVID-19 is throwing the interdependence between business, governments, and society into sharp relief, emphasizing the need to integrate corporate strategy, governance, and decision-making.

And many investors seem to agree. According to a study by Boston Consulting Group, 12 48 percent of investors think it is important for healthy companies to continue their ESG agendas and priorities while navigating the crisis, even if it means lower earnings. These investors understand that sustainability may briefly take a backseat at firms in urgent need of liquidity, but they won’t accept it for long. According to one investor, “We are keeping an eye. We will give them a few months to sort things out, but we will put ESG back on the agenda in the fall.”

Their urgency makes sense. There is growing evidence that firms with high ESG integration will better withstand the crisis and subsequent economic downturn. And ESG funds are outperforming benchmarks. According to Morningstar, these “are the quality companies of the 21st Century, and quality companies tend to hold up better than their lower-quality counterparts in difficult markets.”

“...the COVID-19 pandemic has created a greater opportunity to ask these fundamental questions.

**1. Revisit** company statements of purpose.

- What does value creation mean to your company?
- Does your company have a comprehensive view of how the world is changing, not least given COVID-19, and of its role in that changing world?
- How is your company supporting societal progress and does your corporate culture encourage participation?
- Are your company’s efforts consistent with current sustainability demands and principles?
- Are they in line with the UN Sustainable Development Goals?

**2. Schedule** a meeting of the entire board with the sole purpose of discussing sustainability. Ask the CEO to provide all pertinent information and data on the company’s sustainability progress. Compare leading edge sustainability practices with your own, ensuring ample time for in-depth discussion of:

- The process by which your company identifies risks and opportunities into the medium- and long-term. Is it robust enough, taking the possibility of systemic risks and shocks (like pandemics) into account?
- Gaps between the organization’s current sustainability practices and those it should have;
- Existing strategies for reaching those goals, and strategies needed for future development;

So, has COVID-19 changed the role of the board? Yes and no. “The fundamental nature of our role has not changed,” one participant told us, “we look after the company’s long-term interest and survival. COVID-19 made us realise however that *how* we do that and *what* we should take into account has to change fundamentally.”

**Recommendations for Engaging Boards More Deeply with Sustainability**

So, what can boards do to turn their sustainability aspirations into action? We suggest six approaches which we illustrate with some of the often-difficult questions board members should be asking. If anything, the COVID-19 pandemic has created a greater opportunity to ask these fundamental questions.
The board’s sustainability priorities for short-, medium- and long-term attention, and the intersections between these and the board’s understanding of the company’s purpose.

3. **Audit** the sustainability expertise and mindset of board members.
   - Which sustainability archetype predominates on your board?
   - Do the directors have sufficient expertise and interest to embed sustainability thinking in their processes, risk management, and investment decisions, including mergers, acquisitions, and innovation?
   - Does the board need to recruit new members, perhaps with specialist expertise?
   - How should the board’s membership evolve to make sustainability a priority?

4. **Organize** the board in such a way that it can effectively oversee sustainability.
   - Which board committees should concern themselves with sustainability?
   - Should there be a dedicated sustainability committee and, if so, how will it report to the main board?
   - Does the board have a process by which to plan and act in accordance with a range of events on different timescales, including in times of crisis?
   - Would it help for an independent expert panel to scrutinize the board’s actions and progress?

5. **Evaluate** the information provided to the board on sustainability.
   - Is there a suitable balance between attention to efficiency and resilience?
   - What information does the board currently have and what further information does it need?
   - Does the board have benchmark data by which to judge its performance and that of competitors?
   - Has the board established suitable key performance indicators (KPIs) for management?
   - Does the board need additional resources to better understand or investigate the firm’s sustainability performance?

6. **Explore** how the firm engages with, and learns from, its critics—NGOs and others. Does the board need to hear from them directly?

Providing board oversight in the 21st century requires deep integration of sustainability and ESG factors in corporate strategy, governance, and decision making. Our six approaches, coupled with an appreciation of board director archetypes, should help boards to consider at minimum whether they are best equipped in developing a comprehensive view of where – and to what extent – the materiality of ESG factors is changing and how that may influence financial performance. Equally, it should help them better address the pressing sustainability challenges that affect the communities in which they operate. This is increasingly required to drive long-term growth and profitability.

Many customers, investors, and other key stakeholders have come to expect it.

---

**N. Craig Smith** is the INSEAD Chaired Professor of Ethics and Social Responsibility at INSEAD, France. He is the Director of the INSEAD Ethics and Social Responsibility Initiative (ESRI), at the INSEAD Hoffmann Global Institute for Business and Society, and a specialist professor at the INSEAD Corporate Governance Centre. His current research projects examine boards of directors and sustainability, corporate political activism, the purpose of the firm, the ethics of the “price-tag society,” and whether employees will sacrifice pay for corporate social responsibility. He is the author, co-author, or co-editor of eight books and over forty academic journal articles.

---

**Ron Soonieus** is a Senior Advisor at Boston Consulting Group (BCG), a Founder of Camunico, and an INSEAD Executive in Residence. He has worked with boards and executive management on integrating sustainability and ESG into corporate strategy, governance, and decision making. He helps clients develop a culture of purpose and adopt a sustainable corporate mindset and behaviors. He also serves on the boards of various organizations and is a senior fellow with the Centre for Business, Politics, and Society of the Radix think tank.
Endnotes


8. All the directors are European, seven are women, all are aged 55 or older. The company boards they serve on are mostly European multinationals, some are in the US. Most are listed, a few are family owned. They include several household names and represent a wide range of industries.


Celebrating 10 Years Of Serving Our Community

Offering more articles, series and videos on MBA programs and business schools than any other media outlet in the world, Poets&Quants has established a reputation for well-reported and highly-creative stories on the things that matter most to graduate business education prospects, students and alumni.

Poets&Quants is a community that stays in touch with its readers. We report on and celebrate their success, share in their lessons and trials. Connect with us to stay informed on B-school admissions, news, internships and careers. Visit www.poetsandquants.com.
Many firms believe that the way to cope with environmental violations by their contract manufacturers is through greenwashing initiatives which they hope will protect them from collateral damage. Chris Lo, Christopher Tang, Paul Zhou, Andy Yeung, and Di Fan disagree, arguing that turning a blind eye to polluters in their supply chains can cause major problems for firms.
From Observing to Questioning

On March 23, 2008, a newspaper in Inner Mongolia reported that thirty-nine Chinese workers were exposed to hydrogen chloride, a poisonous gas, while working at a plant belonging to the Northeast Pharmaceutical Group. Founded in 1946 and based in Shenyang, the Northeast Pharmaceutical Group produces chemical synthetic and bio-fermented active pharmaceutical ingredients (APIs) for customers such as BASF Pharmaceutical. Incidents of this kind once fell on deaf ears in China due to inconsistent law enforcement, opaque business practices, and light penalties. However, when news of the incident was reported, the stock price of Northeast Pharmaceutical Group dropped by 2.03 percent on the Shanghai Stock Exchange while that of its customer BASF dropped by 1.05 percent on the Frankfurt Stock Exchange. Was this sudden drop a coincidence?

It used to be impossible to examine this sort of question rigorously because data about polluting plants in China were either nonexistent or inaccessible. However, the 2007 establishment of the Measures on Open Environmental Information (MOEI) by the Chinese government has enabled the Institute of Public and Environmental Affairs (IPE), a Beijing-based nonprofit, to collect data about environmental violations in China. The database developed by IPE has become a renowned source through which overseas buyers, multinational brands and NGOs could monitor the environmental performance of Chinese suppliers. As environmental incidents became more visible (Figures 1 and 2), we wondered if the stock market would respond negatively toward polluters like Northeast Pharmaceutical Group and toward overseas buyers such as BASF who choose to do business with these culprits.

Data Collection and Findings

Using the IPE’s data from 2004 to 2013, we identified 1,833 environmental incidents involving 524 publicly listed manufacturing firms between 2004 and 2013. Given that 1,675 firms were listed in China in 2014, this number represents about 31 percent of manufacturers in China. We then tracked the date of the first public announcement of each violation, the identity of the manufacturer, the characteristics of the manufacturer (in terms of social recognition through the number of relevant awards won, percentage of government ownership according to the Thomson Reuters Eikon database, and political ties through current government position(s) held by its non-executive board members), and its stock price over the relevant time. Because some of these polluting Chinese manufacturers supply other firms, we identified their major overseas customers (according to annual reports), and then tracked those customers from the day before to the day after the public announcement of the violation.

We found empirical evidence that the drop in the stock prices of Northeast and BASF was not a fluke. The share prices of Chinese manufacturers dropped an average 0.41 percent (adjusted for the performance of the stock market) in the two-day period surrounding the announcement of an environmental violation. Moreover, the top five overseas customers of those polluting Chinese manufacturers also saw their stock fall an average 1.13 percent (adjusted for their listing stock markets’ performance).

We also found that greater social recognition (in terms of relevant awards won) can lessen the negative stock returns caused by environmental incidents. This effect is probably caused by the market’s greater confidence that reputable firms will clean up their act. Higher government...
ownership has a similar effect, probably because the market believes that strong financial and political backing will allow state owned enterprises to take corrective action. However, we also discovered that the market will react more negatively when the firm has more non-executive board members in government positions or executives with political ties.

**Implications**

Our research findings have different implications for different stakeholders:

1. **Implications for Chinese manufacturers.** Knowing how negatively the market will react to environmental violations, Chinese manufacturers should recognize a clear economic incentive to comply with environmental requirements and improve environmental performance.

2. **Implications for policymakers.** The Chinese government should continue to ensure the public access to firms’ environmental information so that NGOs, overseas customers, and the Chinese public can join forces in monitoring their compliance with environmental regulations.

3. **Implications for NGOs.** Besides acting as enforcers, some NGOs, such as Greenpeace, the World Wildlife Fund (WWF), and IPE, could independently endorse firms with strong environmental performance. Chinese manufacturers are more likely to act responsibly if there is a carrot, as well as a stick. At the same time, NGOs should continue to educate the public about how air and water pollution can affect them and their descendants and about how they can help to monitor and report environmental violations.

4. **Implications for investors.** Because environmental violations committed by Chinese suppliers have a negative effect on both the suppliers and their overseas customers, investors should focus more on the environmental performance (as well as the social recognition, government ownership, and political ties) of all partners along the supply chain, not just of the firm they invest in.

5. **Implications for consumers.** As consumers gain ever increasing access to environmental information about firms, whether directly through Chinese government websites or through other online databases, they become ever more able to monitor and report environmental violations. More importantly, they can use social media to expose bad deeds and use their purchasing power to pressure overseas companies to take action to ensure their Chinese suppliers’ compliance with environmental regulations.

Now that the Chinese government is improving public access to information about the environmental performance of Chinese firms and imposing harsher punishments for violations, it’s time for everyone to come clean.

---

**Figure 2.** Air pollution caused by coal power plants. Source: BBC China

When choosing a Chinese supplier, overseas customers should evaluate and monitor their environmental sustainability and social responsibility, not just their operational performance. Turning a blind eye to these concerns can create major problems when suppliers violate environmental regulations. Under China’s revised environmental protection law enacted in 2014, all firms operating in China are required to disclose their environmental information. Furthermore, in 2013 President Xi Jinping declared war on environmental pollution, so enterprises are now subject to more
severe penalties for polluting the environment. Now that the Chinese government is improving public access to information about the environmental performance of Chinese firms and imposing harsher punishments for violations, it’s time for everyone to come clean.

**Dr. Chris K.Y. Lo** is an associate professor at the Hong Kong Polytechnic University (PolyU). His research has been published in M&SOM, Organization Sciences, the Journal of Operations Management, and more. He currently directs PolyU’s BA program in fashion and textiles, for which he teaches sustainability in fashion.

**Professor Christopher Tang** is a distinguished professor at UCLA. He holds the Edward W. Carter Chair in Business Administration at the UCLA Anderson School of Management. His current research concerns socially responsible operations and online platforms.

**Dr. Yi Zhou** is a Lecturer in Operations Management in the Department of Management at Monash Business School. His research focuses on sustainable management and global supply chain networks.

**Professor Andy C. L. Yeung** is Chair Professor and Head of the Department of Logistics and Maritime Studies at Hong Kong Polytechnic University. His research deals with operations and supply chain management.

**Dr. Di Fan** is an Assistant Professor at the Hong Kong Polytechnic University. He is a researcher in the area of sustainable operations management and corporate social responsibility.
Today’s businesses need wise, decisive leaders who can operate across cultures and execute in environments of increasing ambiguity. In our programs for individuals and for organizations, Tuck Executive Education at Dartmouth helps develop such leadership. Our personalized approach and famed ground-breaking faculty are the critical factors in creating our environment of engaged learning—an environment that transforms executives and delivers immediately applicable results for organizations.

Visit EXEC.TUCK.DARTMOUTH.EDU today to learn more about our programs:
- Leadership and Strategic Impact Program
- Tuck Advanced Management Program
- Global Leadership: Discover and Create the Future
- Building a Successful Diverse Business
- Growing an Established Diverse Business
- Tuck Next Step: Transition to Business
- Custom engagements for your organization

“In uncertain globalized markets, success demands cutting-edge leadership and strategy. Tuck Executive Education at Dartmouth develops leaders who strategize about what they must do now to create the future, immediately impacting their organizations for the better.”

—Vijay “VG” Govindarajan, Coxe Distinguished Professor of Management at the Tuck School of Business at Dartmouth
Consumers choose economic development over serious climate initiatives. Corporations don’t invest in meaningful change because consumers won’t pay for it. And governments cannot lead if citizens won’t follow. The battle to prevent climate change through behavior modification, regulation, or personal deprivation has already been lost. Yossi Sheffi explains why the solution is collaborative investment in developing technologies that can reverse climate change.
When it comes to sustainability, people claim one thing but do another.

1. The Inconvenient Root Causes
Although 195 countries signed the 2016 Paris Accord, the world has failed to stay on track to meet the agreed upon goals.  

In 2018, the partners in the German coalitions agreed to relax the 2020 emissions target to which the country committed in Paris. Furthermore, it is clearly evident that emissions will continue to increase as a result of consumer behavior and the march of economic development.

When it comes to sustainability, people claim one thing but do another. This tendency is known as the “attitude-behavior gap” in marketing and economic literature. In a Nielsen survey, 66 percent of global consumers said they were willing to pay more for sustainability; and other surveys produce similar results. Yet studies of actual consumer purchasing behavior find that only 5-12 percent of consumers buy sustainable products, despite the typically small price differences. I confirmed this finding in a study my students and I conducted in 2019 using “consumer observation and intercept” in the aisles at four supermarkets in New England. Worse still, the changes that some conscientious consumers do make to their lifestyles may make them feel better but won’t move the needle on sustainability. In fact, consumers who make green choices have been found to have similar environmental footprints to non-green consumers.

Most consumers also show their true colors (not green) at the ballot box. One of the most promising avenues for reducing emissions is a carbon tax because it aligns economic and environmental incentives. Yet even in Washington State, one of the most progressive states in the US, a carbon tax referendum failed for the second time in 2018. Australians voted to repeal their carbon tax and to replace the labor government when the opposition campaigned on the slogan “axe the tax.” People want good jobs, affordable products, and a better life for their children right now, not sacrifice and deprivation in service of a hazy future. And where carbon taxes have been implemented, it turns out that they don’t work very well.

While the most successful carbon tax, enacted in British Columbia, did reduce emissions by 5 to 15 percent; other carbon taxes, levied in sixteen countries, one other Canadian province (Quebec) and one US city (Boulder, Colorado), have reduced annual emissions by only 0.1 to 0.8 percent.

Of course, most of these involve relatively small taxes which, while politically feasible, were never likely to be very effective. Indeed, enacting modest carbon taxes serves primarily to placate an environmental minority by making them feel that governments are doing something, regardless of the tax’s impotence.

The current scale of the climate change challenge suggests that, despite setbacks at the ballot box, governments will ultimately try to bite the bullet and enact both high taxes and tough regulations in order to force a green economy. Yet the choices their citizens make bind the hands of governments on climate-related matters. And people who are thwarted at the ballot box will use more forceful methods, like the months-long violent demonstrations in Paris and other French cities which were triggered by a proposed carbon tax of only twelve cents per gallon on fuel (about a two percent increase). The French made it clear that they were not willing to shoulder a higher tax burden in the name of the environment. Voters’ displeasure at stagnant standards of living also affected both the Brexit vote and the 2016 US presidential election. Carbon taxes are unfortunately seen as impeding the growth of standards of living. And when standards of living do not rise, the ugly heads of nationalism and radicalism rise in their place. So governments, too, prize short-term economic growth and jobs over long-term prognostications of planetary peril.

And sometimes environmentalists are their own enemies. Nuclear energy can be an important part of reducing greenhouse gas emissions. Unfortunately, environmentalists have consistently fought against building more nuclear plants on the grounds that the waste generated by nuclear plants remains radioactive for tens of thousands of years. Two of the leading candidates for the 2020 Democratic presidential nomination call for banning new nuclear plants and phasing out all existing ones. Yet it seems odd to worry about 10,000 years in the future when climate scientists warn of catastrophic consequences only decades from now. Nuclear power could at least be part of an interim solution until either clean energy becomes widespread or new research on scrubbing carbon out of the atmosphere at scale yields workable solutions. Another component to a long-term solution would be focusing nuclear research on fusion, in which isotopes are merged, rather than fission, in which uranium 235 isotopes are split. Fusion is what powers the sun. It produces far more energy than fission and creates considerably less radioactive material. Unfortunately, at the moment, fusion barely works in the lab; scientists are still working to control the process in a contained space and make it create more energy than its containment consumes.

2. Corporate Initiatives
Without the benefits of flat currency and the strong arm of the tax collector to amass money for sustainability, companies face even tighter
constraints than governments. Consumers who don’t like the price and performance of a company’s products can switch suppliers far more easily than citizens can change home countries. Business is therefore even less able to pick up the climate change slack left by apathetic consumers and politically-constrained governments.

To placate a vocal green minority, most companies offer “sustainability theater,” highly visible but relatively minuscule improvements.

To placate a vocal green minority, most companies offer “sustainability theater,” highly visible but relatively minuscule improvements. Restaurants stop using plastic straws, though the environmental effect is negligible and paper straws cannot be easily recycled (unlike plastic sones); hotels ask guests to reuse towels (but still don’t charge for fresh ones); and retailers eschew single-use bags, even though reusable bags are not always the best environmental choice – all of which amounts to “pretend sustainability.” Companies tout their commitment to reducing carbon footprints and other environmental impacts, but most of these programs are just cost saving initiatives with a green marketing veneer. These much-publicized incremental solutions are a fig leaf which corporations and governments use to cover their lack of substantive action. And by promoting these initiatives, companies give the public a false sense of progress, counteracting the efforts of social pressure.

Still, some companies do try... and yet:

- As part of its “fuel sense” program, FedEx initiated 45 fuel-conserving projects, such as requiring pilots to taxi on a single engine and ground crew to keep gates clear and quickly connect ground power to incoming aircraft. The company boasted that, through these programs and aircraft modernization, it saved 177,000 gallons of fuel in the 2017 fiscal year. While these efforts are certainly commendable, 177,000 gallons is a mere 0.1 percent of the jet fuel FedEx Express used that year.
- In 2015, at the same time that Greenpeace was lauding Apple for embracing clean energy, the online investigative organization Truthout, was vilifying the company for its high CO₂ emissions. That two NGOs could arrive at such diametrically opposed conclusions about the company illuminates an important fact about corporate claims and supply chains. Greenpeace’s analysis focused on Apple’s internal operations: buildings, data centers, and retail outlets owned by the company. Truthout, by contrast, took a holistic approach that included the emissions of both the upstream and downstream supply chains associated with the manufacturing and use of Apple’s products. Apple’s two leading Chinese suppliers, Foxconn and Unimicron, were accused not only of creating deplorable working conditions which led to employee suicides, but also of polluting rivers and ground water with factory chemicals.
- Truthout estimated that the vast majority (72.5 percent) of Apple’s life cycle carbon footprint was in its suppliers’ operations. This conclusion is not surprising. Like Microsoft, Cisco, and many others, Apple does not make any of its products; it outsources all manufacturing to contract suppliers, many of them in China. Truthout went on to assert that Apple’s products had a high ongoing footprint during use. Although Apple did create energy-efficient data centers, iPhone owners use apps produced by Facebook, Google, Samsung, Twitter, and millions of other websites and services that run on carbon-intensive, non-Apple servers. From Apple’s own reporting, Truthout estimated that Apple’s own facilities represented a puny 1.2 percent of the company’s supply chain emissions.

- FIJI Water’s sustainability efforts include changing its distribution patterns, using square (plastic) bottles, and pursuing community initiatives. However, the company still transports its water more than 10,000 miles by ship and thousands more by truck all over the United States. Any other attempts to cut emissions are dwarfed by the emissions inherent in transporting water over long distances. FIJI’s slogan, “Good for the environment,” while lauded by the media, was proven empty when two different California lawsuits forced the company to rescind its environmental sustainability claims.

- While commercializing the building blocks of a renewable economy, companies like General Electric and Siemens continue to support the growing emissions of the old economy. They build wind turbines and tout their environmental credentials in slogans like GE’s “Eco-Magination” and Siemens’s “Ingenious for Life.” Yet, both companies continue to build and service coal and gas-fired power plants around the world. Indeed, GE’s entire Eco-Magination effort was dubbed “greenwashing.”

All of these are examples of what David MacKay calls “twaddle emissions” in his analytical book “Sustainable Energy: Without the Hot Air.”

Many other companies are even less scrupulous. In its environmental reports, Volkswagen boasted that it “develops its products and services in the most environmentally compatible way.” Although some of Volkswagen’s
efforts may actually have been beneficial, they must be balanced against its massive outright emissions fraud. VW engineers deliberately rewrote the engine management software in their cars to detect laboratory testing conditions and return the engine in such a way that it would test well, but be no fun to drive. After testing, the software would revert to driving (and polluting) mode. Between 2009 and 2015, VW installed this “test defeat” software in some 11 million cars. The company’s diesel Jetta, for example, produced emissions 4,000% higher than US regulations allowed. I mention this episode not in an effort to shame one company, but to suggest that even in a country awash in green education, media, and culture, engineers and executives not only contemplated but engaged in such anti-green activities.

For the poor half of the world, environmental sustainability is a luxury.

3. The Developing World

Even if the developed world suddenly and wholeheartedly embraced emissions-restricting measures, nearly half of humanity still struggles on less than $5.50/day, according to the World Bank.\(^{29}\) For the poor half of the world, environmental sustainability is a luxury. In addition, there are many people in the developed world in the same situation. For example, 50 million Americans now live below the federal poverty line.\(^{30}\)

Moreover, as the poor improve their lot, they will expect to live in concrete buildings, use air conditioning, have home appliances, eat more meat, and drive cars – changes that inevitably increase carbon emissions.

The “China miracle” shows both the human gains and the environmental costs of this progress. China moved from a staggering 99 percent extreme poverty rate in 1978 to essentially eliminating extreme poverty by 2014. However, as the country industrialized, lifting hundreds of millions of people into the middle class, \(\text{CO}_2\) emissions surged by more than 2,000 percent between the 1960s and 2017. In January 2018, the New York Times reported that China’s emissions were more than those of the US and Europe combined and were still rising.\(^{31}\) And China is not alone; most countries that have reduced poverty rates have also substantially increased their emissions.\(^{32}\) In India, the government plans to continue producing electricity from coal “for decades to come.” In 2017 it issued a nine-point plan to increase coal production\(^{33}\) in order to provide electricity to an additional 304 million people.

One can only imagine the environmental impact of bringing the world’s remaining 3.4 billion impoverished people into the middle class. Naïve insistence on aggressive sustainability initiatives is perceived by consumers as hardship, by companies as lost market share, and by politicians as instability. The root cause of all parties’ insufficient action is their universal quest for a better life through growth. People seek higher standards of living; companies seek better returns; politicians seek power by promising prosperity.

These natural preferences ensure that nobody will sacrifice much for the climate. Companies cannot make real (and expensive) change until consumers are willing to pay for it. Governments cannot legislate real change lest they be voted out of office. Most countries will therefore not hit their 2020 and 2030 Paris emission targets, and global emissions will keep growing.\(^{34}\) China is still firing up new coal plants; its emissions will keep growing.\(^{35}\) These natural preferences ensure that nobody will sacrifice much for the climate. Companies cannot make real (and expensive) change until consumers are willing to pay for it. Governments cannot legislate real change lest they be voted out of office. Most countries will therefore not hit their 2020 and 2030 Paris emission targets, and global emissions will keep growing. China is still firing up new coal plants; its emissions will keep growing. The real inconvenient truth is that the current efforts to change consumer behavior and inspire self-imposed austerity seem to have no discernible effect. Something else needs to be done.

The real inconvenient truth is that the current efforts to change consumer behavior and inspire
self-imposed austerity, like flight shaming, selecting slower e-commerce delivery, and so forth, seem to have no discernible effect. Something else needs to be done.

4. What Should Companies Do?
In the short-term, companies should focus on several categories of initiatives:

- **Eco-business** – companies in the business of environmental sustainability are “riding the wave” of interest in the fight against climate change. Their products include solar panels, wind turbines, energy-efficient appliances, LED lighting, and so forth.

- **Eco-efficiency** – these are the sustainability initiatives that reduce cost (or improve service) and should thus be enacted anyway. Johnson Controls, the largest supplier of automotive batteries, operates a closed loop of recycling, recovering 99 percent of the materials from used batteries. This operation isolates it from the volatility of commodity prices; for example, between 2000 and 2010, world lead prices oscillated between $500/ton and $2,000/ton.36 Companies like Walmart will adopt initiatives that pass their internal hurdle rate. Others, such as Staples, set a hurdle rate for sustainability initiatives that is somewhat lower than their standard one.

- **Eco-hedging** – some companies believe that as millennials enter their prime earning and spending years, they will demand more sustainable products. These companies have begun to experiment with introducing green products: getting familiar with the materials, the suppliers, the manufacturing techniques, and the market segment that may look for such products in the future. For example, The Clorox Company developed Green Works, a family of sustainable cleaning products. While small and not profitable, it provides the company with data about suppliers and consumers while allowing it to understand the products’ chemistry and efficacy, in case the market changes.

- **Eco-risk-mitigation** – is the motivation for most corporate sustainability initiatives today.37 Brand name companies don’t want to be the nail that sticks out and gets hammered down. Attacks by NGOs, consumer groups, and the media can damage sales and stock prices. As a result, companies want to at least be perceived as “doing something.”

Beyond these short-term initiatives, companies should realize that current actions are not likely to reverse climate change and start adapting: shifting offices, factories, warehouses, and suppliers away from locations likely to be disrupted by climate change and closer to the most probable eventual sources of low-carbon energy. By so doing, they will also naturally attract others — their employees, families, and supporting businesses — to safer and lower-carbon locations.

**The Way Forward**
The world faces an impasse — a tragedy of the commons on a planetary scale. Consumers, companies, and governments insist on ever-better living conditions while driving the planet to ever-worse environmental conditions.

The environmental movement’s multi-decade educational and persuasion efforts have met with limited success. While CO₂ emissions per dollar of GDP have declined in many countries, global GDP has been rising at a faster rate. Efforts to live sustainably may have achieved some minimal reduction of emissions in the developed world, but the billions of poor and lower middle-class people in the world cannot conserve their way to prosperity.

Corporations have likewise enacted only limited conservation efforts, except where these efforts also happened to reduce costs, improve service, or satisfy other economic goals. These efforts are also not likely to make a big difference; sustainability programs large enough to move the dial will require substantial changes in products and processes, and require consumers to accept higher prices, inconvenience, limited choices, and other service degradation. In addition, most of the low-hanging fruit in fuel and energy-efficiency has already been claimed during the decades of competitive cost pressures and social pressure for corporate sustainability. Once a company has replaced incandescent bulbs with LED bulbs, it can’t just do it again. Each efficiency improvement is a single step “win,” and subsequent steps become harder to find and more expensive to deploy.

In the absence of a global cultural change in people’s expectations, making them willing to live with (a lot) less, we must rely not on policy or behavioral changes, but on technological advances.

In the absence of a global cultural change in people’s expectations, making them willing to live with (a lot) less, we must rely not on policy or behavioral changes, but on technological advances that can be adopted on a large scale. Renewable technologies are, in several cases, already cheaper than fossil fuels, but their use is limited. Only 11 percent of US energy production comes from renewables38 despite
significant government support, such as a 30 percent tax credit for solar photovoltaics, accelerated depreciation for businesses, and the option of selling unused power back to the grid. With these federal subsidies about to shrink\(^9\) (the tax credit will be only 10 percent by 2022), the rate of conversion to renewables is likely to slow down. The US has also phased out the production tax credit available, until 2019, to utilities that invest in renewable technology. And even as the economics of renewables become more favorable, the inherent intermittence of sun and wind power may limit their use at scale. Meanwhile, fossil fuels are still getting massive government subsidies. In fact, an International Monetary Fund study shows that fossil fuel subsidies represented a staggering 6.5 percent of global GDP in 2017, a fact which can be deplored, but not ignored, and another reason why we cannot rely on government actions.

As this article is going to press, the world is in the midst of the novel coronavirus pandemic. What we are going through is likely to exacerbate the problem of long-term sustainability efforts (even though emissions are likely to improve with the recession in the short term). Not only will many of the world’s citizens end up poorer as a result, the massive bailouts enacted by governments around the world (the initial US bailout is more than a quarter of the country’s annual GDP), will drain government coffers, limiting any other investments and further reducing citizens’ willingness to pay for sustainability.

I believe that the solution will be technological. Technology is driving the increasing efficiency of renewable energy production and the reduced cost of some components. To appreciate the impact of technological change, note that between 2007 and 2016, the country that reduced its emissions more than any other country in the world was... the United States!\(^{40}\) This surprising achievement was not caused by low-carbon policies, by a shift to renewables, or by conscientious consumers. It was caused by fracking technology. The shale boom caused the price of natural gas to drop by about 60 percent,\(^{41}\) making it cheaper than coal and driving a massive conversion of US heavy industry and power generation from coal to gas. Natural gas has half the carbon footprint of coal or oil so US carbon emissions decreased. Fracking (essentially an eco-efficiency initiative) was relatively easy to adopt on a large scale because it delivered something consumers and companies actually wanted: cheaper energy. And importantly, it was a technological breakthrough, not a political or cultural one.

This history hints at the direction needed for future environmental solutions. Emissions will continue to grow. And even if renewables continue to seep into electricity production, the change will not be nearly enough to reverse climate change.

Neither the developed nor the developing world will sacrifice their standard of living and aspirations to the extent that many green plans require. Future large-scale technological solutions will thus have to mitigate and reduce new emissions while economic activity goes forward.

Unfortunately, even if all current emissions reduction processes could be inexpensively scaled up, they would not halt climate change. Indeed, even if all emissions around the world suddenly ceased this afternoon, the atmosphere would still be burdened with all the CO\(_2\) which has accumulated since the industrial revolution.\(^{42}\) That accumulated CO\(_2\) would continue to drive inexorable changes to the climate for years or decades to come.\(^{44}\) So the earth will continue to warm, the ice sheets will continue to melt, the oceans will rise, and mega storms will get bigger. Our greatest efforts, therefore, should be focused on taking carbon out of the atmosphere in order to halt and reverse climate change. Researchers trying to develop such solutions on a practical scale have dubbed the field carbon capture and storage. The goal is to capture, transport, and store atmospheric CO\(_2\) securely, and to do it at scale. In many ways, the easiest way to make carbon capture technology work is at the source of emissions, capturing the CO\(_2\) from power generation and industrial processes before it reaches the atmosphere.\(^{45}\) Still, while smokestack CO\(_2\) sequestration helps to reduce new emissions, it does nothing to remove old CO\(_2\) from the atmosphere.

Our greatest efforts, therefore, should be focused on taking carbon out of the atmosphere in order to halt and reverse climate change.

Researchers at leading universities are now working on various methods to remove the CO\(_2\) already in the atmosphere.\(^{46}\) The most promising strategy, known as direct air capture, involves circulating air over
chemicals which absorb carbon dioxide, preparing it for sequestration. This method succeeded in the lab and several companies are trying to commercialize it. However, it is still expensive, and it remains to be seen whether it can be used economically on a large scale. The price of carbon sequestration must, of course, be balanced against the potential cost of not reducing the carbon in the atmosphere and continuing to add more. Still, putting large sums into research and development could yield significant results.

5. Making It Happen
It is certainly possible that the ongoing UN Conference of Parties (COP) events, pressure from environmentalists, and the views of young people will motivate governments to act on a scale commensurate with the threat. These actions could include significant carbon taxes, constraints on the mining and use of coal, limitations on travel, curbs on the sale and consumption of meats, and limits on economic growth. They would also have to involve tough moral choices by or about the developing world. But none of this is very likely to happen. The fracturing of political willingness to cooperate worldwide, as blatantly demonstrated during the Madrid COP in December 2019, has left governments not just unable to convince their citizens to make do with less, but actively suggesting that taking substantial initiatives will leave them unable to compete with countries that do not enact such regulations.

As a result, many environmentalists now feel that the burden falls on responsible companies to act, arguing that because they profess concern about global warming, they should turn from “sustainability theater” to real efforts to combat global warming. Still, no single company can act alone without consumers who are willing to pay directly for sustainability. It will put them in an uncompetitive situation and endanger their business. By working together, though, companies can make a difference. First and foremost, they must stop the pretend sustainability efforts that amount to sophisticated greenwashing. Instead, leading multinationals should pool their resources to invest in research on carbon sequestration and removal, which seems to me to be the only feasible path forward.

In August 2019, the Business Roundtable released a new statement of the purpose of the corporation. In it, 181 CEOs committed their companies to work for the benefit of all stakeholders – customers, employees, suppliers, communities, and shareholders. As I and many others have pointed out, the statement was largely devoid of substance. The total revenue of the participating companies is $7 trillion, with a pre-tax profit of more than $800 billion and tax payments of about $150 billion. The group could comfortably contribute hundreds of billions of dollars to an international fund for research into technologies to reverse climate change, which would be far more powerful than rhetoric and symbolic green initiatives. Moreover, the companies listed in the Business Roundtable are a small fraction of companies worldwide which could jointly generate billions of dollars for such a research fund. Combine this with philanthropic contributions, matching government funds and prestigious international prizes and one can imagine a massive international fund dedicated to this research. Naturally, enacting such a collaborative effort would face many hurdles. Governments and other donors will need encouragement to join corporations in the effort. If certain corporate leaders will show the way, though, they will influence the public to demand collective action.

Although some companies may be freeloaders, examples of successful international cooperation do exist. These include the Montreal Protocol to ban substances that deplete the ozone layer, and the MARPOL convention to limit maritime pollution from ships. Many international organizations also foster constraints on and payments to collective bodies working for the common good. These include the EU, OECD, the World Bank, the World Health Organization, a range of UN organizations, and many more. All of these organizations and agreements required countries and companies not only to contribute monetarily, but also to agree to abide by certain principles that limited their own influence or power in the name of a shared objective.

Even though it is clearly smarter to produce energy without emitting CO₂ than it is to emit CO₂ and try to capture it, the world has to embark on an R&D path dedicated to actively removing carbon from the atmosphere. So much CO₂ has accumulated in the atmosphere already and we are nowhere near ending the growth of emissions.

6. Conclusion
We may not know all the personally, politically, or commercially palatable solutions to climate change at this time. It is obvious, though, that addressing climate change by trying to influence people toward personal sacrifice and deprivation isn’t working now and doesn’t seem likely to work in the future. Our efforts to increase the proportion of renewables in energy production should continue and accelerate, but these largely affect electrical power generation and not other energy uses, nor do they address the carbon already in the atmosphere. Furthermore, it is not clear that the rate of adoption of renewables will outpace the rate of growth of GHG (greenhouse gas) emissions in the developed and developing world.
Companies which look to the long term can help society create the economic resources to address the global challenge of adaptation, emissions reduction, and atmospheric carbon removal. To do so, they must end their fake sustainability campaigns and turn their focus to funding the development of new scalable carbon sequestration and storage technologies. These companies can lead the way by contributing the anchor funding for a massive, international, research effort – a moonshot – to bring the current technologies up to the necessary scale and develop new ones that will reverse climate change and enable humanity to continue improving its standard of living.

Companies which look to the long term can help society create the economic resources to address the global challenge of adaptation, emissions reduction, and atmospheric carbon removal. To do so, they must end their fake sustainability campaigns and turn their focus to funding the development of new scalable carbon sequestration and storage technologies. These companies can lead the way by contributing the anchor funding for a massive, international, research effort – a moonshot – to bring the current technologies up to the necessary scale and develop new ones that will reverse climate change and enable humanity to continue improving its standard of living.

The ever-increasing evidence of the effects of climate change has yet to drive most people to alter their behavior and demand meaningful changes in products, services, and policies. While some believe that the technologies to solve the climate challenge exist, this view ignores the fact that these technologies are not being adopted at the rate and scale that would make a difference in time. As long as current efforts and trends continue, the climate battle has already been lost in the short-to-medium term. Even though renewables keep getting cheaper and some governments have enacted modest carbon taxes, the scale of the actions is nowhere near matching the urgency and magnitude of the problem. It is high time we apply human ingenuity and the global industrial network to adapt to the inevitable and invest real resources in developing long-term solutions.

Endnotes

4. Note: this paper was written before the onset of the Coronavirus recession.

Yossi Sheffi, Elisha Gray II Professor of Engineering Systems, is director of the MIT Center for Transportation and Logistics. He has founded five successful start-ups as well as the MIT SCALE international network, launched an online program reaching 350,000 learners, and authored five award-winning books, including “Balancing Green: When to embrace sustainability in business (and when not to)” (MIT Press, 2018). For more information see sheffi.mit.edu.
23. https://www.wanderlust.co.uk/discover/discover-fiji/content/fiji-volunteer-nature-sustainability-projects/  
30. Oxfam: Poverty in the USA. https://policy-practice.oxfamamerica.org/work/poverty-in-the-us/?tsa_tgt=kw%3D94768827&hsa_grp=63001026018&hsa_src=g&hksa_net=adwords&hsa_mbp=0&hsa_ver=3&hsa_ad=284792059&hsa_acc=535988318&hka_kw=pos%201%20in%20us&hsa_cpa=1490296257&gcid=EAlaILuQobCMIIfl9NCwpIAA1vKxFBRliu4wkEAYASTAAEglAP-PDF_BwE  
36. Johnson Controls also recycles the plastic housings of batteries to make new housings. And it recycles the acidic liquid electrolytes inside the battery and reuses them in new batteries or supplies them to makers of detergents and glass. Having a domestic supply of lead instead of relying on imports from foreign lead producers such as China, Australia, and Peru also insulates Johnson Controls from currency exchange rate volatility  
42. https://informationisbeautiful.net/visualizations/how-many-gigatons-of-co2/  
43. By comparison, the average emissions per capita worldwide is 4.8 tons CO2 (of course this ranges from 10 ton in the Australia to 0.3 in Afghanistan).  
47. Companies include Carbon Engineering in Canada, Climeworks in Switzerland, and Global Thermostat in the US.  
In response to Yossi Sheffi’s article, “The Real Inconvenient Truth,” Mayers and Koomey argue for the use of a variety of urgent measures to address climate change, rather than focusing primarily on long-term development and dependency on carbon capture and storage. Citing the now competitive cost of renewable power and the success of several countries in enacting programs that address climate change, they urge the need for optimism.
We would like to respond to Yossi Sheffi’s article, “The Real Inconvenient Truth,” which pessimistically suggests that most current efforts to reduce carbon emissions will be unsuccessful and will involve too much “sacrifice and deprivation” for consumers to stomach. Sheffi’s article argues that nuclear power expansion could have played an important role if campaigning environmental activists had not acted as “their own enemies.” In the short term Sheffi recommends that, ideally, companies should focus on developing ecotechnology (including renewables and energy efficiency measures) but suggests that the effectiveness of such technologies will be limited by consumer willingness to pay. Sheffi argues that the solution is a longer term “moon shot” investment in the capture and storage of carbon from fossil fuel power generation, industrial processes, and the atmosphere itself (direct air capture). This perspective is not particularly new; it’s fairly common amongst sceptics of current climate action.\(^1\)

Although carbon capture and nuclear power are both important in tackling climate change, ultimately they can only produce part of the necessary reduction in emissions, and expanding renewable energy is cheaper, hands down. The United Nations has identified a number of additional means of reducing emissions and meeting climate targets.\(^2\) These measures can all be achieved without bringing misery to consumers:

- Expand renewable energy e.g. wind, solar, and biofuels
- Electrify end use of energy e.g. transport, heating
- Improve energy and fuel efficiency e.g. transport, industry, buildings
- Incentivise use of low carbon products and services e.g. public transport
- Increase efficiency of using materials with high carbon impact e.g. cement, iron, and steel
- Phase out energy production from coal
- Link energy access to emission reductions for 3.5 billion ‘energy poor’ people
- Prevent clear-felling of forests
- Reforest and grow plantations on unforested lands
- Adopt soil conservation practices in farming

These are undoubtedly big tasks to organise on a global scale and will require international financial investments. But they will not cause economic development to grind to a halt. According to estimates from the Intergovernmental Panel on Climate Change (IPCC), taking steps to address climate change would reduce annual global economic growth by only a tenth of a percent, roughly (about 0.04%-0.14% per year).\(^3\) This expense would be considerably less than the substantial and incalculable economic damages of a 3°C warming scenario.\(^4\) The current COVID-19 crisis provides a stark example of how an uncontrolled global crisis can play out, with the global economy predicted to actually shrink (-3% GDP growth) in 2020.\(^5\) By contrast, these proposed steps will create employment opportunities and marketable innovations while reducing smog and pollution. Although these benefits are difficult to estimate precisely, they are expected to help counterbalance mitigation costs and support alternative economic growth.

Generating and storing electricity from wind and solar power installations is now cost-competitive with power generation from fossil fuels.

Renewable Power

The improved economic outlook for renewables is particularly encouraging and is only getting better. Over the last decade the cost per unit of renewable energy has fallen rapidly as we have gained experience and learned from new innovations (see figure below). Generating and storing electricity from wind and solar power installations is now cost-competitive with power generation from fossil fuels.\(^6\) If we take an only slightly optimistic view, at the current trajectory of adoption, renewables have the technical and economic potential to deliver a substantial chunk of the reductions needed.\(^7\) Targeted use of natural gas also plays an important role, because it is highly efficient, relatively inexpensive, and responds quickly to demand. It is therefore an excellent counterbalance to the variability of renewable power generation.

Carbon Capture and Storage

The various technologies for capturing and storing carbon dioxide are still in their infancy and are comparatively expensive. Their widespread development and adoption would substantially increase the cost of fossil fuel fired energy generation, and with it the cost of energy to consumers.
• Carbon capture from coal-powered electricity generation: In 2019, building new coal plants with carbon capture and storage cost about $152 per MWh. Installing new commercial solar and onshore wind generation cost only $32-42 and $28-54 per MWh respectively.

• Direct carbon capture from air: Coal plant chimney gases can have CO$_2$ concentrations of around 15 percent. In contrast, CO$_2$ is present in the atmosphere only at a trace levels (around 0.04 percent by volume), which makes it difficult and expensive to extract directly from air. The extraction alone can cost up to $1,000 per ton of CO2 captured before the additional costs of storage! To put this price in context: even by a recent optimistic estimate, meeting 2030 global emissions reduction targets through direct air capture would incur costs equivalent to as much as 4 percent of the worldwide economic output before storage. It would also consume the equivalent of a quarter of the global electricity supply. These demands make the widespread adoption of carbon capture almost inconceivable.

• Carbon capture from bio-energy fuels: Carbon capture from biofuels (not specifically mentioned in Sheffi’s article) could remove CO$_2$ from the atmosphere more economically than direct air capture. Plants capture carbon, which is burned to produce energy, and the resulting CO$_2$ is then captured and stored. In theory, this approach could reduce emissions by up to 22.5 Gt of CO$_2$ equivalent (out of 33 Gt of total energy-related emissions in 2019). It would also, however, require the conversion of 80 percent of cropland and would push the planet’s limits for freshwater use, soil health, and biodiversity. Consumers would also see a substantial increase in energy costs because biofuels are persistently more expensive than gas and diesel. Meanwhile the additional costs of carbon capture are estimated at $30-280 per ton.

Nuclear Power Generation: Admittedly, it is relatively cheap to generate electricity with existing nuclear reactors (around $29 per MWh). Shutting down those reactors would certainly slow progress towards emissions reduction targets. The main barrier to nuclear expansion, however, is the rising cost of new reactors, not a minority of environmental naysaying campaigners and NIMBYists. Reactor costs have increased by 20 percent over the last decade, largely because of industry specific expenses like the need for better safety measures. The cost of electricity from new nuclear installations is therefore much higher than that of electricity from new wind and solar facilities (at $118-192 per MWh). Furthermore, the International Energy Agency (IEA) estimates that doubling nuclear energy output globally would produce only one seventh of the carbon emission reductions needed. Nuclear fusion, rather than fission, might theoretically do better, but it does not present a foreseeable solution anytime soon.
Carbon capture is not a magic bullet that can solve climate change by itself; we must acknowledge the interdependency of our paths towards a solution.

Sheffi’s article presents a relatively pessimistic view of our current efforts to reduce carbon emissions, even going so far as to label them “pretend sustainability.” It advocates the long-term research and development of carbon capture and storage as the solution. If, as Dr. Sheffi suggests, emissions continue to rise despite our best efforts, then carbon capture will not be able to run on renewable power and will, itself, generate additional snowballing emissions that must be captured. In this eventuality, the costs of halting climate change would escalate to truly untenable proportions. Carbon capture is not a magic bullet that can solve climate change by itself; we must acknowledge the interdependency of our paths towards a solution. Sheffi’s article also misses a very important point: we can’t wait for an expensive long-term gamble on carbon capture and storage - we need urgent action in the short term. Let us consider the impact of climate change on living standards if we don’t take sufficient action over the next few years. This impact is proportional to the overall accumulation of CO₂ in the atmosphere. If we are to avoid an escalation of the type of crises prevalent all over the world in recent years, substantial reductions in carbon emissions are needed soon (50 percent over the next decade to keep warming from rising more than 1.5 or 2°C from pre-industrial levels). It is not only a minority of passionate environmental activists that recognise this need.

Blackrock, a company managing $6.47 trillion in assets (as of March 31, 2020), decided to remove from its portfolio all companies generating more than a quarter of their revenue from thermal coal production, and to push for the removal of CEOs who fail to act on climate risks.

The book "Cold Cash, Cool Climate: Science-based Advice for Ecological Entrepreneurs" is a useful reference for anyone looking to navigate this field and plot a serious course to tackle climate change. We can and are redesigning systems. We can improve both products and services, like electric vehicles or intelligent heating / cooling systems, while simultaneously lowering emissions. These improvements are not one-off reductions, as Dr. Sheffi’s article suggests, but will continue to keep emissions low for years to come. Meanwhile, innovation is opening new markets while new knowledge is reducing the cost of adopting new emerging technologies at scale. Addressing climate change does require urgent commitment and action by governments, industry, and individuals (as highlighted at the recent United Nations Climate summits in New York and Madrid in 2019). We do need to move our discussions beyond ‘sustainability theatre,’ as Dr. Sheffi rightly points out, and it’s true that current commitment and action fall short. But none of this means that our actions have been or will be entirely futile. For example, the failure of any regulation to hold individuals or companies to account, like the emissions scandals in the automotive sector, does not justify inaction. Instead, it underlines the need for more effective government policy and enforcement. Regulators have certainly not been idle in this regard. In the case of VW, executives have resigned and been charged with criminal offences, fines and car rework costs have run into several billions of dollars, and VW share prices fell by more than a third as the news broke in September 2015.

Encouragingly, entire countries have enacted successful efforts and, in so doing, provided leadership on how to proceed. For example, the latest third quarter figures from 2019 show that renewable energy accounted for 38.9 percent of the UK’s electricity supply and that the percentage supplied by coal was in single digits. Costa Rica has been recognised as UN Champion of the Earth for its ambitious commitments to the Paris Climate Agreement. Ninety-eight percent of its energy is renewable, and its forest cover has been restored to 53 percent of its land area after decades of intense deforestation. These achievements prove that there is a way, where there is political will. We consider that good enough reason for optimism over pessimism, for action over inaction. Let us then proceed on the basis of both empirical evidence and scientific expertise. Academic research gives us vital insights with which to better inform and educate governments, industry, and society on the path ahead.

Acknowledgements

The authors would like to thank Tom Davis and Prof. Luk Van Wassenhove for their input and proofreading help.
Endnotes

1. See the Skeptical Science website, an excellent scientific resource. https://skepticalscience.com
Yadie Smith, the celebrated English novelist, is quoted in the New York Times as saying, “people who believe in fundamental and irreversible changes in human nature are themselves ahistorical and naïve.”

I argue that, beyond sustainability theater, companies will never produce something that their customers will not buy or that they have to sell at a loss. Similarly, legislators will not enact substantial regulations contrary to the desires of their citizens, lest they be voted out of office.

The Mayers and Koomey response to my piece did not address my most basic premise – that the majority of consumers are not willing to pay more, or be even slightly inconvenienced, for sustainable products or services. Off the record, the sales, distribution, and supply chain executives of any large company will...
attest to this fact. It has also been proven by many studies based on actual experiments, rather than on opinion surveys. This truth is the fundamental root of my argument. Mayers and Koomey believe that companies can bring about change in spite of what consumers and citizens want and do. I argue that, beyond sustainability theater, companies will never produce something that their customers will not buy or that they have to sell at a loss. Similarly, legislators will not enact substantial regulations contrary to the desires of their citizens, lest they be voted out of office. Instead, as I have described, they restrict themselves to regulations that are too timid to make much of a difference, if any.

As I write this, the world is falling toward a deep recession that is likely to continue for years. It seems reasonable to expect that even more people -- unemployed, worried, and frugal -- will begin to perceive sustainable products as luxury goods.

As I write this, the world is falling toward a deep recession that is likely to continue for years. It seems reasonable to expect that even more people -- unemployed, worried, and frugal -- will begin to perceive sustainable products as luxury goods.

I envy those who can ignore the lack of progress, the public resistance, the failure of important (green) countries to comply with the Paris Agreement, the inability of the Madrid COP to reach a comprehensive agreement, and the dearth of meaningful regulations.

1. No argument with the first point. I am as worried as they are about global warming and even more worried about relying solely on hopes and the good intentions of the public. I characterized the situation in my paper as a “tragedy of the commons on a planetary scale.”

2. I envy those who can ignore the lack of progress, the public resistance, the failure of important (green) countries to comply with the Paris Agreement, the inability of the Madrid COP to reach a comprehensive agreement, and the dearth of meaningful regulations. These optimists seem instead to rely on anecdotes and corporate news releases to sustain them. Fifty years after the first Earth Day, increasing worldwide emissions, and a growing reliance on coal in many developing countries, suggest that our current incremental efforts are not enough. Mayers and Koomey do not address the fact that more than half of humanity is still striving toward a middle-class life with air conditioning, cars, steaks for dinner, and concrete housing. Given these facts, there is no indication that our current efforts are anywhere close to addressing the global warming challenge.

3. Like the first point above, this overview of renewables seems rooted in a misunderstanding of my position. Not only do I believe the problem is real and severe, I also urge continuing current efforts, such as the use of renewable power. As Mayers and Koomey mention, I did write that “companies should focus on developing ecotechnology (including renewables and energy efficiency measures).” So why do they conclude that I call for “inaction” and dismiss the importance of renewables? My only concern about renewables is that the data suggests the movement to renewables is not working fast enough.

As I freely admit in my article, carbon sequestration is expensive and unproven at scale. But I am optimistic.

4. As I freely admit in my article, carbon sequestration is expensive and unproven at scale. But I am optimistic. As they realize that our current efforts are not up to the challenge we face, more and more scientists and engineers will turn to...
developing new technologies, including better, faster, cheaper carbon sequestration methods. My hope is that these scientists and engineers will not be lulled into inaction by the naïve optimism expressed in Mayers and Koomey’s response to my article but will continue pushing the technological frontiers.

Like many well-meaning environmentalists, Mayers and Koomey seem to take comfort in unexamined corporate pronouncements and press releases. Consider their argument that: “Even Blackrock decided to remove from its portfolio all companies generating more than a quarter of their revenue from thermal coal production...” Really? First, let us note that Blackrock had one of the worst environmental records in the world before that announcement.² Even after the announcement and the corresponding “divestiture,” Blackrock will remain one of the world’s largest investors in fossil fuel companies.³ And why companies which get 25 percent or more of their energy from coal; why not 10 percent, or zero? Moreover, the new policy applies only to its $1.8 trillion “active fund.” As a result, the “divestiture” will affect a scant $500 million in holdings, or 0.00007 of its $7 trillion in assets.⁴ Finally, on May 17 2020, the Financial Times reported that Blackrock refused to back the environmental resolutions of Australian oil companies. Its headline read: “BlackRock accused of climate change hypocrisy.”⁵ I see BlackRock’s original announcement as a prime example of greenwashing, reported by a few wide-eyed and lazy media outlets, and leading well-meaning yet gullible environmentalists to think (or rather hope-against-hope) that Blackrock is on their side and the world is changing.

Mayers and Koomey argue: “Let us then proceed on the basis of both empirical evidence and scientific expertise.” Surely that evidence should include a hard look at the data and not just hopeful optimism.

Endnotes

2. Patrick Greenfield, World’s top three asset managers oversee $300bn fossil fuel investments,” The Guardian, October 12, 2019
3. 6.7 percent stake in Exxon Mobil, 6.9 percent in Chevron, and 6 percent in the mining company Glencore, among others.
Service Industrialization, Convergence, and Digital Transformation – I

Digital technologies have significantly changed service industries, the largest segment of the US economy. The convergence of the creation, consumption, and delivery processes of services across a range of sectors, followed by rapid industrialization, has had a powerful effect on revenues, job shares, wages, and sector structure. Uday Karmarkar explains why companies must respond to these challenges rapidly or risk being perpetual laggards.

Uday Karmarkar,
UCLA Anderson School of Management, UCLA
Digital transformation is of central interest to companies in every industry. The forces driving change include new technologies, a rapidly evolving competitive environment, and the resulting need for flexibility, resilience, and continuous innovation. Leading technology providers, industry observers, and company advisors are casting this transformation as a “plug-and-play economy” or an “API economy,” both terms that capture the increasingly modular nature of business and production as well as the concurrent need for flexibility and speed in reconfiguring them. The B2B (business to business) and systems landscape is moving toward the philosophy of everything as a service while many companies are outsourcing or even discarding any processes that are not their core competitive capabilities.

Many sectors producing B2C (business to consumer) goods are following suit as their products become technology enabled or smart. Among the recurring themes in the popular business press today are the network economy, the gig economy, and the sharing economy. Many news stories warn of the dangers which automation and robots pose to jobs and employment. Not so long ago though, the leading concern was offshoring and job flight, threats which are actually greater than ever. Although there is a practical reality behind all of these issues, they can seem fragmented and confusing.

In fact, all of these concerns and concepts can be fruitfully viewed as facets of an overarching process of service industrialization, which consists of a common set of technology enabled process strategies which managers often implement locally and independently to make their companies more competitive. The consequences of these strategies can legitimately be called a revolution with all that the term implies. In addition to the effect on jobs and incomes, many service sectors are being significantly disrupted while firms are driven to restructure and even reinvent themselves. The impact of this process is magnified by the size and growth of the service sector, which already dominates all the major economies in the world.

The path of industrialization starts with the information and communication technologies that are transforming the chain of service creation, processing, delivery, and consumption. The “back rooms,” or the internal working processes of companies, were industrialized over a long period starting with the advent of calculating machines, typewriters, phones, and computers. Logistics systems for information and service delivery began to develop with telecommunications and expanded with radio and TV broadcasting before evolving further with the internet and the web. This back room industrialization is now migrating to the cloud, to web services, outsourced and off-shore vendors, and software-as-a-service (SaaS). Today we are seeing a new phase in the service industrialization of the front office, the customer facing side of a company. That often involves server based platforms interfacing over the internet with personal devices to enable service access for predominantly mobile customers. We will examine the effects of industrialization on the economy, and on various business sectors and processes and their mixed consequences, which are mostly good for consumers but sometimes less so for jobs and companies.

The shift to services in the US and other developed economies has long been apparent. Services account for more than 85 percent of the US GDP. Furthermore, within the services sector, value is shifting from physical services to information intensive services. Information intensive product and service sectors together make up over 60 percent of the US GNP, while the share of information intensive services alone is almost 57 percent. Other developed economies, such as those of Sweden and S. Korea, show very similar patterns. One particularly visible instance of change due to industrialization is the decline of music distribution, news publishing, and other traditional content-based services. Transactional services such as retailing and financial services are also being rapidly transformed while sectors like book publishing and education are on the cusp of potentially massive disruptions. The continuing impact of these changes on back room and front office white collar workers will soon be as serious as that which we have already seen with manufacturing jobs.
processing. But a new service revolution is not a singular event; it is the accumulated result of innumerable decentralized decisions made by managers, entrepreneurs and investors over decades. We refer to this process as service industrialization because of the extensive intersection and interaction between services and information technologies, and because the effects of new technologies on services came early and with considerable force. These massive structural effects of industrialization have had broad consequences including sector restructuring, sector disruption, and the emergence of new services. They also have powerful implications for management strategy and public policy.

**Service Industrialization**

Service industrialization refers to the application of technology, often in concert with reengineered and standardized processes, intended to increase profits, quality, demand, and market share. This transformation is sometimes termed the “productization” of services, and indeed the effects of industrialization often make services look a bit more like products. Nonetheless, the key defining aspects of services remain, including provision on demand, no transfer of tangible assets, infeasibility (or illegality) of reselling the service, interaction and co-production with customers, and a need to actively manage customer experience either in person or online. By understanding that industrialization does not transform services into real products, managers can gain a sharper and deeper perspective on the resulting changes in process economics, their competitive effects, and the strategic options available to them.

Service industrialization is, in many ways, analogous to the 19th century’s industrial revolution in manufacturing. It is a true revolution in services that substantially alters the entire economy as well as affecting social conditions and the distribution of jobs, income, and wealth. Service industrialization is the set of actions and decisions facilitated by new technologies, that includes:

- **Automation** of process steps and information logistics, enhancing speed and capacity;
- **Outsourcing and offshoring**, or moving some processes out of companies and dispersing them geographically inside and outside a country;
- **New service creation** often introduced by new companies which make more effective use of new and emerging technologies;
- **Service and process redesign**, in both the small and the large, sometimes radical;
- **The repositioning** of companies and restructuring of sectors;
- The creation of **new markets, exchanges**, and networks using communications which may be many to one, one to many, or many to many;
- **Online distribution and delivery** to devices along with closer engagement with individual customers and networked groups;
- **Self-service** or shifting work to consumers and **moving operations** to other stages in a chain.

Many of these approaches are similar to those which transformed manufacturing, though the last three are not. Along with the effects on profits and quality, they also tend to increase productivity, which is a fundamental driver of consequences for the total economy, and for sectors and markets. But while increased productivity is generally beneficial for the economy as a whole, some of the consequences, like increased income inequality and the job losses which can follow severe disruptions, are less positive.

While physical processing advances tended towards large scale centralized production, information processing has gone towards miniaturization, mobility and dispersion across devices and geography.

The nature of the technologies which underlie service industrialization has spurred considerable changes in service process economics. During the industrial revolution, increases in processing capability were accompanied by increased need for motive power, and by economies of scale in processing facilities. By contrast, information processing resources have achieved enormous performance improvements, as captured by Moore’s Law about chips, but with simultaneous reductions in the power, space, and weight requirements needed for each unit of computational power, data transport, and storage capacity. These changes have been accompanied by physical miniaturization and portability. So while physical processing advances tended towards large scale centralized production, information processing has moved towards dispersion across devices and geography. There are undoubtedly still economies of scale which centralize some computing and storage resources, but mobile devices show an ever increasing capacity for computing and data storage. The advent of the Internet of Things (IoT) and the proliferation of microelectronic and electromechanical devices (MEMs) will accelerate this dispersion.

From an economic perspective, one effect of these new technologies is a dramatic decline in the cost of information processing and
Services quickly become commoditized, similar in appearance and function, with seemingly interchangeable substitutes quickly available. Apart from look and feel, differences of localization or geographic specialization also fade, further spurring intense competition within and across market segments.

logistics. For information intensive businesses, both the fixed and variable costs of end-to-end processes have become small compared to their output. Entry into these markets is therefore easier and price competition more intense. Technology also affects service design. While the external look and feel of a physical product can often be copied for a price, functionality is much more difficult to reproduce. The same is not true of information intensive services which are highly vulnerable to copying, both in visible design and underlying function. Even poorly built copies can be indistinguishable from the original to customers who only see the user interface. The result is that services quickly become commoditized, similar in appearance and function, with seemingly interchangeable substitutes quickly available. Apart from look and feel, differences of localization or geographic specialization also fade, further spurring intense competition within and across market segments.

Service industrialization is now also affecting physical services that once seemed immune to technological change. The impacts on logistics, retailing, trucking, and counter services are becoming ever more apparent. Even some manufacturing sectors have begun to see “servitization” and the growth of asset sharing micro-markets encourages a further shift towards services, with rentals replacing ownership. Common traditional examples of servitization include bundling warranties and repair services with products, or providing financial assistance for equipment purchases. An early example of more extreme servitization was Xerox’s strategy of leasing rather than selling their machines, and then charging the user for the number of copies made. That price discrimination and forward integration strategy was also effective in allowing customers to adopt novel and expensive equipment at low initial expenditures and low risk. Today, automotive companies are beginning to position themselves to enter the car rental and ride services market. Although these companies once found forward integration into rental services unattractive, it is now a preemptive defense against the looming disruption potential of changing ownership patterns for autonomous vehicles.

Convergence in Information Services

While the term convergence is overused and often too broadly and loosely applied to everything from designs to devices, it is nonetheless an important feature of information intensive services. Within those sectors, convergence determines process structure, costs, economics, and the nature of competition. Convergence is a deep phenomenon that applies to information intensive services on many levels. The most fundamental of these is digitization or convergence in form. Since all information, including sounds, images, and more can be conveyed as bits, all forms of information look the same at a process level. This cannot happen with physical products where materials can at best only be partial substitutes and the actual trend is towards ever more variety. A direct consequence is a convergence of logistics in that the same methods of transportation, storage, and delivery work for all kinds of digitized information. This trend means high volumes of activity for those stages, but also significant commoditization. For example, transportation of all digitized information runs through the same telecommunication channels, such as optical fiber, legacy copper lines, and radio transmission through the air using a spectrum of frequencies. Once again this is very different from material supply chains and physical service networks where storage and transportation systems vary widely across sectors and the supply chains for, say, cars and clothes will never converge.

The next direct consequence of digitization is the convergence of processing. The same equipment, either in centralized servers or on distributed devices, is used to process all kinds of information, alphanumeric, graphic, audio, or video, regardless of sector, source, and end use. The same resources process entertainment content, data analytics, financial services and consumer searches. This universality is now producing a convergence in hardware even at the chip level, where low cost, low power RISC (reduced instruction set computer) architectures, which use a small but optimized set of instructions, are widely used not just in mobile devices but increasingly also in servers. Similarly, graphics chips are ever more widely used because of their utility in parallel processing which applies to many tasks like searches and data processing. In effect, the logistics chains of information intensive sectors – from factories
and roads to warehouses and retail stores -- are converging into one common system.

Going further, we also see a convergence in processes within sectors. The production and business processes of different companies within a given sector begin to look very similar, if not the same. While there may be small differences in the processes and in the way they are implemented, there is little variation in form, cost, or performance across firms in the same sector, whether the service is content distribution, e-commerce, or retail banking. Companies within a sector thus face broad commoditization, more intense competition, and a pressure to differentiate their services somehow, and to build whatever entry barriers they can.

Finally there is a form of convergence in use or consumption, though this is a fuzzier pattern. Adults in the US now face screens of one kind or another for more than ten hours a day. A quarter of US adults describe themselves as “almost constantly” online, sometimes for work and sometimes for leisure. Either way, there is no longer a clear separation between work and leisure periods. The traditional notion of how our use of different media – and therefore our exposure to advertising messaging – was divided between work and home time is blurring. People now routinely interweave their work and non-work time. As devices, work, and consumption become ever more mobile, the locations of both the workplace and leisure activities are less fixed. More important now is the size of the screen required for a given activity, which can still determine location. Much is done on a small personal screen – contributing to our isolation – while large screens may be used for professional work or social events.

Convergence also has a significant impact on the structure of information intensive service sectors. Cloud and web services such as infrastructure as a service (IaaS), platform as a service (PaaS), unified communications as a service (UCaaS), and software as a service (SaaS) have appeared and grown rapidly. Because logistics and processing are the same across sectors, third parties find it economically viable to sell these functions as services, inviting firms to rent or lease capacity as needed rather than buying and installing it on site. IT resources move from being internally managed on-site to something which looks much like a traditional utility, and capital expenditures become operating expenses. Meanwhile consumers use these same devices, operating systems, and browsers for a range of activities. So convergence again produces intense competition for these services with many entrants and dropping prices. In this environment, the biggest firms are the most likely to survive due to the scale of their server use, their capacity for lateral expansion, the strength of their brand and presence, and their pooling economies of scale with respect to access, demand queues, task queues, and processing capacity. To differentiate themselves, suppliers will continue to bundle adjacent services and add new services at a high rate.

### Table 1: Digitization and Vertical De-integration of the Consumer Photography Sector (2000-2020)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Capture</td>
<td>Film Cameras</td>
<td>Digital Cameras</td>
<td>Mobile Devices (phones)</td>
</tr>
<tr>
<td>Storage</td>
<td>Film</td>
<td>Local Digital Storage</td>
<td>Cloud and Local Storage</td>
</tr>
<tr>
<td>Processing</td>
<td>Photo-finishing</td>
<td>Digital Processing</td>
<td>Digital, Automated</td>
</tr>
<tr>
<td>Master Copy</td>
<td>Photo Negative</td>
<td>Digital File</td>
<td>Digital File</td>
</tr>
<tr>
<td>Distribution</td>
<td>Paper Print</td>
<td>Electronic File</td>
<td>Exchanges, Networks</td>
</tr>
<tr>
<td>Archiving</td>
<td>Print/Negative</td>
<td>Local Digital Storage</td>
<td>Cloud and Local</td>
</tr>
<tr>
<td>Delivery</td>
<td>Print</td>
<td>Digital File, Download</td>
<td>On-demand Streaming</td>
</tr>
<tr>
<td>Consumption</td>
<td>Print</td>
<td>Screens</td>
<td>Mobile Screens</td>
</tr>
</tbody>
</table>

**Vertical De-integration and Horizontal (or Lateral) Dominance in Information Services**

One consequence of digital technologies and convergence is the vertical de-integration of sectors which could also be thought of as modularization of information service process at the industry level. An immediate result of this change is the appearance of lateral or horizontal dominance, in which companies start to provide resources and services that cut across sectors at stages (such as transport) where those sectors have converged.

Consider the case of home photography, which can be thought of as a self-provided consumer service. This sector has been digitized and industrialized in a comparatively short time (Table 1). For a century, the industry was vertically integrated and dominated by Kodak and Fuji, with Agfa Gevaert and others far behind. While both the leaders did produce cameras, the key to their dominance was film. Producing film is technically difficult and has a high startup cost. Film also tied together image capture, storage, processing, archiving, delivery, and end consumption which allowed the leading companies to completely dominate the entire chain. Once photography was digitized, however, the film...
Based vertical disappeared. Cameras still remained part of the chain, but their cost dropped radically and consumers turned in ever increasing numbers to using phones to take photos, and at volumes much higher than ever before. Costs are low for the camera itself and it uses no consumables. Worldwide sales of photographic film peaked before 2000, and had nearly vanished just 10 years later. The same happened with film-based cameras. Now, the extent of de-integration, commoditization, and anonymity of service and resource providers is going further. Photo storage is moving to the cloud. Stand-alone digital camera sales peaked in 2010 and have continued to decline. Cameras are primarily on phones with videos beginning to overtake still photos and distribution performed largely through exchange sites and platforms.

So digitization has vertically de-integrated photography, with some stages converging across sectors while others are functionally decoupled. Image information is easily transferred in standardized file formats with no loss of quality. Processing, storage, transport, and consumption all use unspecialized equipment that is employed across a range of sectors. The software required for processing is of low cost or free. The result is a modular process which offers little technical or economic reason to tie different stages together and thus increases competition within those stages.

But while vertical integration declines, companies providing technology and equipment operate horizontally across many sectors (as shown in the last two columns in Table 1). As a result, these firms, whether in telecommunications, server capacity, storage, or consumer devices, can become very large. The stages which provide some differentiation are at image acquisition (the camera) and in the software for processing content. But the cameras are cheap and usually bundled with other devices and, while image processing software is different from the editing software used for publishing or audio engineering, it is at historically low costs or even free. Neither stage can provide high profitability. This kind of restructing of sectors with vertical de-integration and horizontal or lateral dominance is occurring across all information intensive services.

### Entry, Differentiation, Platforms, and Bundling

In order for an established firm to remain profitable while new companies try to enter its sector, there must either be some barriers to entry, or the firm must find some way to differentiate itself. A combination of both is ideal so that differentiation does not devolve into tiny niches and fragmentation. Table 2 shows, by stage, the typical pattern for entry barriers, differentiation, and the resulting process structures for information intensive sectors. Low entry barriers naturally encourage new entrants, spurring fierce competition. And because the new technologies are equally available to all players, there is little room for differentiation through expertise in technology, processing, or functionality. Web services and the virtualization of servers have made processing into a basic utility with flexible capacity which is available on demand at a competitive cost, and easily scaled to immediately match changing needs. Capital expenditures become operating expenses which are similar across firms. With extremely low transport and logistics costs, the result is low margins and intense price competition.

Still, there are a few stages which present opportunities for companies to differentiate themselves. At the information creation or capture stage, there is a window for extensive differentiation or for entry driven by novelty. But the ensuing variety can be so high – consider music or novels – that the result is fragmentation into small niches. These can have high unit margins but are rarely capable of expansion into large businesses at the creation stage alone.

### Table 2: Entry Barriers, Entry, and Differentiation in Information Service Process Stages

<table>
<thead>
<tr>
<th>Process Steps</th>
<th>Barriers to Entry</th>
<th>Differentiation</th>
<th>Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creation/Capture</td>
<td>Low</td>
<td>Very high</td>
<td>Fragmentation</td>
</tr>
<tr>
<td>Acquisition/Aggregation</td>
<td>Medium</td>
<td>Low</td>
<td>Low Margins</td>
</tr>
<tr>
<td>Content Processing</td>
<td>Low to Medium</td>
<td>Low</td>
<td>Low Margins</td>
</tr>
<tr>
<td>Storage</td>
<td>Low</td>
<td>Low to None</td>
<td>Commodity, Low Margins</td>
</tr>
<tr>
<td>Transport</td>
<td>Very High</td>
<td>Very Low</td>
<td>Commodity, Low Margins</td>
</tr>
<tr>
<td>Service Provision</td>
<td>Medium</td>
<td>High</td>
<td>Segments and Brands</td>
</tr>
<tr>
<td>Web Sites/Access</td>
<td>Low</td>
<td>High</td>
<td>Segments</td>
</tr>
<tr>
<td>Devices/OS</td>
<td>High</td>
<td>Reducing</td>
<td>Brands, Design</td>
</tr>
</tbody>
</table>
Transport (telecommunications) has very high barriers to entry. However, simply moving bits is an extreme commodity, so that competition is intense and margins are low even though there are just a few very large traditional telecom companies at the core of the system. Processing can be somewhat differentiated across industry sectors. However with the standardization of files and data, since the inputs and outputs are the same, it is hard for firms in the same sector to differentiate their service on the basis of processing methods even though internal algorithms might actually be different. Standardization also lowers entry barriers, inviting entry even by small companies.

The end consumption devices and operating systems (OS) also offer opportunities for differentiation. However, the OS layer has been rendered unprofitable by Google’s introduction of Android. This was a way to disable competitors that might otherwise have controlled access to the customer. This has happened before when Microsoft bundled a web browser (Internet Explorer) with their OS, and effectively killed the pioneering Netscape browser. Companies have found some success in differentiating devices, but it appears that designs are now converging, despite legal efforts to protect them. So while Apple has heretofore been a design leader in mobile devices, it has begun to recognize rising competition from Asian firms, accompanied by the inevitable impending pressure on prices. In response, Apple appears to have begun a strategic shift from devices to services, a symptom of which is the recent departure of their key designer, Jonathan Ive.

Nonetheless, new firms are still able to establish themselves, grow to great size, create brands, and become very profitable. They have often found this success at the service creation, response, and delivery stage, from which services are provided to customers on demand. For content based services, that stage is the delivery or streaming server. For financial services it is the server where transactions are executed in response to customer requests made through a web site. For a functional service like search it is a search engine, coupled with an ad server. All these examples are essentially about creating platforms. While functions differ across sectors, the basic processing hardware and software which underpin service platforms have converged. Within a given sector, companies must achieve superior functionality through better algorithms and interface design to create a better look and feel. This server stage is the locus for both functional differences across sectors and differentiation and segmentation within sectors, and occasionally for superior functionality or usability. Managing customer experience at this stage is thus of ever increasing importance in allowing companies to build their brand and differentiate themselves from competitors.

Bundling strategies play a complementary role to service delivery platforms. We have already mentioned how convergence facilitates the lateral or horizontal extension of resources and equipment for service providers. This same convergence of underlying technologies, along with some functional differentiation, lets companies adopt bundling strategies. Although information service sectors used to be quite distinct, it has become apparent that many firms which operate massive service platforms are now able to bundle other services along with their putative primary offering. These services may, at the outset, be tangential to their initial offering but, more and more, there seems to be no practical limit to the extent and reach of bundling. Once again, lateral bundling strategies for growth, scale, and brand building replace vertical integration. Currently, Google and Amazon are perhaps the broadest service bundlers, while Apple appears to have just recognized the importance of broadening its service bundle and moving beyond its focus on devices. The overlaps between these service bundles are increasing, and firms that once seemed to be in completely different sectors now compete directly.

**Mobility, Demand Shifts, and the Role of Consumers**

In any service, traditional or industrialized, consumer experience remains important. In traditional services, the customer was usually physically present. But consumer experience is no less important for the success of digital and industrialized services, even though the customers may not be physically present. The nature of digital service interfaces ensures that the consumer is effectively a closely coupled part of the service system, with information and interactions flowing rapidly back and forth. It is therefore vital that companies routinely consider and analyze consumer experience at the consumption stage as well as the technologies and devices that affect that experience (see Tables 1 and 2 above).

Consumers know that there is no fundamental technical reason for delivery of services to fall short of excellence, since the tools, technologies and design ideas are equally available to all firms at reasonable cost.
Recent technological trends have rapidly moved people toward increased mobility as a growing proportion of the world’s population enjoys easy access to online services. In response, the market for electronic devices has expanded rapidly from desktops and living rooms to individuals. This dispersion has increased device market size to the millions and billions. Consequently, the importance of the end customer has soared. The consumer base is likely to be micro-segmented, with ever more refined customization of service available down to the individual person. Combined with the compelling experience of interactive and networked communications, this individual tailoring has led consumers to spend substantially more, in both time and money, on devices and services. But there are still aspects of consumer demand and behavior that challenge both private and public organizations. Consumer expectations about service delivery are no longer limited to specific sectors. Instead consumers form opinions based on their best and worst experiences, regardless of service type. Consumers know that there is no fundamental technical reason for the delivery of services to fall short of excellence, since the tools, technologies, and design ideas are equally available to all firms at reasonable cost. Many companies in the service sectors are working to adapt to these converging consumer expectations, but the process is by no means complete and many organizations still operate in very traditional, even old-fashioned ways.

Management Implications and Service Strategies

In responding to these rapid changes, the most important thing for any company to do is to take an end-to-end, long-term view of their sector and their role within it. As the example of photography illustrates (Table 1), many industries have already changed in radical ways. The pace at which technology drives change is so rapid that even technology leaders, with a sophisticated understanding of the field, have faced unforeseen problems and have missed opportunities, sometimes irretrievably. Others are in the midst of urgent repositioning, with varying degrees of success. While Sony is still a presence in consumer electronics, it has lost its leadership position to Apple and Samsung. Ironically, although the company’s early success was rooted in transistor radios, it failed to recognize the technology enabled demand shift to mobile screens. Content based businesses like music and news have declined sharply with little prospect of recovery. Book publishing has had a brief recent respite, but the end game is clear. And the point of disruptive change is often far from a company’s post position, so that it is easily overlooked until it’s too late. Intel is still repositioning after being late to recognize the shift to mobile and low power devices in which it did not have a strong position, while the desktop market declined.

Another important defensive step is to systematically scan, with a certain degree of paranoia, for approaching threats from new technologies and new entrants. A major threat in many sectors today is the appearance of very large, cash rich, brand rich, and tech savvy players, who are using lateral expansion across sectors as a primary growth strategy. The biggest of these are firms like Amazon, Google, Microsoft, and Apple which are constantly growing laterally. As their core businesses become saturated and commoditized, or as generational demands shift, companies like Facebook and the telecoms also appear to see horizontal expansion as a path to survival and growth.

However, many companies still have a long way to go in enacting basic industrialization strategies, both internally and externally with customer and supplier facing processes. Automation of functions is most often about the instantiation of traditional processes as software. Well defined transaction based processes are the easiest to automate, whether internal to firms or outward facing. Content management, including external content delivery, content acquisition, processing, and storage, is already largely automated. Well defined functional processes in both back rooms and front offices are increasingly amenable to automation, even in very complex knowledge-based decisions like medical diagnosis. The methodologies which fall under the umbrella terms of data analytics, business analytics, and artificial intelligence (AI), are enabling substantial new levels of automation in areas ranging from security management, to retail pricing, and the dynamic customization of processes.

The network of hardware and software technologies called the Internet of Things (IoT) also represents a major step forward in automation. The IoT is made up of a diverse collection of devices and technologies that combine sensors, radios, actuators, and increasingly complex control and decision-making software. Its applications range from simple identification with RFID tags and sensors for data collection, to sense and respond systems and autonomous devices, including such extremely disruptive technologies as self-driving vehicles. While the internet and web created information chains extending from screen to screen, IoT tools and technologies create connections between objects, sensors, machines, computers, and people, to create complex networked systems encompassing all those diverse
entities. Smart transportation, energy, security, health care, and homes are early examples of applications which will soon become ubiquitous. Their operation will account for the largest data flows and transaction volumes in the internet of the future.

While services have traditionally been localized due to physical factors, information intensive services are highly portable and can be provided remotely. The globalization of many such services is already feasible and offers valuable opportunities for increasing market reach and cost advantages. Telecommunication companies globalized early, though many are now pulling back from certain markets due to the intense competition resulting from commoditization and too many entrants. Financial services, customer support (call centers), and content delivery are already dispersed globally. US financial service companies are beginning to create global back rooms, but, except for cases like Citibank and American Express, do not yet have an extensive worldwide presence. Retail banks from many other countries appear to be more globalized than their US counterparts, though some have had to retreat due to intense competition in commoditized online banking channels.

Although industrialization and convergence have caused the vertical de-integration and modularization of many sectors, there are certain cases in which judicious and limited reintegration has been valuable. Many companies now look to forward integration and direct-to-customer channels for visibility, accessibility, and brand recognition. In some cases, supporting service back-rooms and consumer devices can complement one another. Apple’s first portable consumer device, the iPod, owed some of its success to the iTunes library, even though the latter was not a big source of revenues or profits. Apple is now moving to increase its role as a content supplier and as a service channel. These areas are complementary to its strength in devices and consumer experience. Although Google and Amazon have not been successful in producing revenues with their forward integration into consumer devices, this is a result of an on-ramp strategy which ensures that their customers always have an easy pathway to their services, while weakening their competition by offering alternative routes to the same end. When Google acquired Fitbit, its goal may have been more about access to the associated data than about profit from delivering content or other functionality. Conversely, content distributors like Amazon and Netflix are finding that it is not enough just to have huge libraries of content, since their competitors inevitably catch up, causing price competition to increase. Their natural response is to look in the other direction and integrate backward into content acquisition, project funding, and eventually production.

One emerging strategy that is further driving the trend toward services is so-called servitization or everything as a service (XaaS). The term servitization was originally used to describe the bundling of pre- and post-sales services with products. Adding financial services to help consumers purchase a car or selling maintenance contracts and repair services, added profitable service lines to products with limited or shrinking margins. When bundled with products which face increasing global competition, services can partly localize a product and help to lock in the customer. The current trend toward a sharing economy takes this concept to an extreme, encouraging consumers to rent products as a service rather than buying and owning them. While the concept is not new, it is spreading into many new areas. Web and cloud services are turning computing, storage and communications into a utility. In the B2C world, so-called “micro-mobility,” consisting of sharing vehicles from scooters to cars, is a highly visible current form. The rental model even extends to personal items such as apparel, accessories, toys and household goods. These micro-rental platforms are feasible in part because of the reduction in transaction costs and because automated online markets offer effective search-and-match functions, small transactions, and micro-payments. They also rely heavily on interactive communications and online reviews, allowing customers to enforce vendor reliability, improving trustworthiness and quality.

**Implications for Public Policy**

The combination of service industrialization and its resultant economic trends have a range of consequences for social welfare, many of which call for action by policy makers. Decisions to industrialize naturally lead to a growth in productivity, but the results of that growth are mixed. On one hand, increased productivity results in an increase in average wealth. However, it can also increase income inequality as wage shares for some occupations rise, while those for others level out or decline. Wage differentials were historically correlated with education levels. However, a closer look reveals that certain white-collar occupations are now waning in job share as well as wage share. At the same time, high wage white collar jobs which require specialized professional or technical education are increasing in share. So higher levels of professional education will still tend to have high rates of return but much college education may not.
Unfortunately, education choices are often made early, and once made are not easy to change later in life. What’s more, the fields which tend to show higher returns often cost more and have higher requirements for admittance, including entry exams and past grades. A result is mismatches between education and job requirements leading to unemployment in one field accompanied by unfilled jobs in another.

A major consequence of service industrialization is its impact on jobs.

For a given sector, higher relative productivity growth can initially create economic growth in GNP and job shares. Eventually, however, that trend reverses and the sector begins to decline. Manufacturing has followed this path in many developed economies and, like agriculture, will probably do so in every economy. Within services, we are seeing a growth of information intensive services and a leveling of physical services. But that trend is likely to reverse just as it did for manufacturing. A major consequence of service industrialization is its impact on jobs. While services will still be the largest source of jobs, some large service sectors are likely to shrink in job share. Information intensive firms clearly tend to have very large revenues per employee and to create comparatively few jobs. In other sectors, technology and industrialization disrupt job locations and availability. Already, the San Francisco Bay and Seattle areas are booming because of the presence of technology providers, while manufacturing locations like Detroit, Cleveland and Buffalo have been in decline. Industrialization is now causing declines for basic, white collar, information intensive service jobs which are mostly located in large metro areas.

Summary

The US, along with most other economies, is in the middle of a dramatic economic shift brought on by technology-driven service industrialization. This rapid change has major effects on all levels, from individual jobs and firms to industry sectors and the national and global economy. The consequences of this process are mixed. On one hand the average wealth will increase, and consumers will benefit in terms of cost, convenience, and new consumption opportunities. On the other, gains in productivity will lead to job losses, while shifts in employment patterns and the substitution of capital for labor will increase inequality of income and wealth. The most notable recent shift for jobs, only visible in the aggregate over the last decade, is a substantial decline in white collar jobs for both front office and back room occupations. There have already been significant disruptions for industry sectors related to content distribution. More disruptions are yet to come for several other sectors that still seem to be grossly unprepared.

Managers must learn to continually assess new technological advances and to constantly scan their industry sectors from end to end, though still with an eye to the underlying needs of customers. A small change in a seemingly distant stage can be extremely disruptive quite quickly, like the trend toward consumer mobility and its effects on chip demand and consumer electronics. Finally, for any type of service today, incursion by new entrants, bringing new service designs and industrialized processes that render traditional formats obsolete, is a constant and major danger. One of the largest of these changes, with global implications, will be the impending advent of autonomous intelligent devices, including drones and self-driving cars, and of the new services these devices will require.

A small change in a seemingly distant stage can be extremely disruptive quite quickly.

End Notes


Uday Karmarkar is LA Times Chair of Technology and Strategy and Distinguished Professor at the UCLA Anderson School of Management. His research interests include the digital economy, service industrialization, and competitive strategy. He earned a B.Tech. from IIT Bombay and a Ph.D. from MIT. He is an Honorary Fellow of IIT Bombay, and a Fellow of MSOM. Professor Karmarkar has undertaken projects on digital transformation, manufacturing, and services strategy with more than fifty organizations in the US, Europe, and Asia.
18. Servitization or servicization refers to the enhancement of product offers with bundled services, or the conversion of product offers to services. E.g.: https://chiefexecutive.net/servitization-growing-manufacturing-model/ (accessed on 6/20/19).
22. https://www.fieldtechnologiesonline.com/doc/an-introduction-to-rfid-0002 (accessed on 11/05/19)
When navigating the uncertainties of digital technologies, vigilant firms gain an edge by paying close attention to what is happening on their periphery and fostering organizational agility, so they are ready to act when the time is right. George Day and Paul Schoemaker examine three key principles that underpin organizational vigilance and show how Adobe’s leaders used them to great effect.  

George S. Day,  
The Wharton School, University of Pennsylvania  

Paul J. H. Schoemaker,  
The Wharton School, University of Pennsylvania
At some point, nearly every leadership team will miss a critical signal that they could - and should - have caught. In the past, these missed warnings might have moved slowly enough to allow reactive organizations to regroup and respond. But today’s environment is one of digital turbulence where change is faster, erratic, and less predictable. This condition of instability and fluctuation requires greater speed, the skilled management of uncertainty, and often transformative business models, while strongly penalizing tardy responses.

Vigilance is much more than a single individual’s heightened alertness; it is characterized by collective curiosity, candor, and a willingness to play the long game which must be nurtured throughout the firm.

To successfully navigate this relentless upheaval, firms must become more vigilant so they can see risks or opportunities sooner and act faster. Vigilance is much more than a single individual’s heightened alertness; it is characterized by collective curiosity, candor, and a willingness to play the long game which must be nurtured throughout the firm. Above all, vigilance enables firms to anticipate threats, recognize opportunities sooner than rivals, and act when the time is right. Vigilant organizations deftly use market probes and experiments and then make small bets to explore emerging markets or technologies. In so doing, they create flexible options that are easy to unwind or expand as needed, giving them a head start when the fog of uncertainty lifts. Without this degree of flexibility, firms can only react to events as they go by and much of their freedom to maneuver is lost.

Adobe’s digital gamble.
By 2009, Adobe’s image-editing program Photoshop was so popular it had become a verb, joining the elite few like Xerox and Google. Yet its growth prospects were still sluggish and the ubiquity of smartphones soon allowed everyone to be their own photo editor. A steep drop in cloud computing storage costs, forecast to be as much as 40-50 percent a year, loomed on the horizon. Adobe could clearly spot the emerging threat, with deep-pocket rivals like Google, Oracle, IBM, or Microsoft likely to use this emerging digital capability to enter its market.

The leaders at Adobe worked quickly, redefining the threat of the cloud as an opportunity to imagine a new creative process combining desktop and mobile to offer new capabilities. In November 2011, the company moved from selling boxed software on disc, which gave the user a perpetual license to one iteration of the program, to a cloud-based subscription service for fifty dollars a month.3 Adobe’s most loyal customers were outraged by the shift to a software-as-a-service model, reluctant to rent rather than own and to store their content in the cloud.4 But the company pressed forward and in May 2013, simply stopped providing upgrades for its boxed software; further innovations would be available only via the cloud.

Adobe’s calculated gamble has been handsomely rewarded: its revenue more than doubled to $11.17 billion between 2011 and 2019, and net profits more than tripled from $832 million to $2,951 million. So how did Adobe exercise such far-sighted vigilance and take advantage of this nascent opportunity before its potential rivals?

Vigilant companies like Adobe follow three principles for navigating digital turbulence. First, they direct their attention to the most vital and active parts of their orbit. Second, they instill a sense of prudent urgency throughout their organization. Finally, they build the array of skills needed to become more agile. Taken together, these three principles can surmount the destructive, siloed thinking that concentrates attention only on immediate tasks. Leaders who embrace them take a longer view that lets them see the future sooner.

How Digital Technologies Intensify Turbulence
Digital technologies are transforming how we process information, learn, make decisions, and interact. If we consider Gordon Moore’s 1965 paper on computational trends as marking a starting point, the digital, computational, and communications revolutions have been underway for more than 50 years with, to date, a roughly billion-fold improvement in performance. The dramatic improvements in digital fabrication brought about by these advances are just one example.
Today’s 3D additive printers are the beginning of a powerful shift in which data can be turned into objects, from food to furniture to golf clubs. The hyper-localized production of (almost) anything may one day overcome the constraints of fragile global supply chains.

The interwoven nature of digital technologies is depicted in Figure 1 and suggests nearly endless possible combinations. The eight digital technologies shown in the outer ring as examples can be both sources and products of other digital advances, enabling further capabilities.

These new digital capabilities are themselves made possible by breathtaking advances in computer system performance, including processing, storage, communication, and data analysis, shown in the inner ring of Figure 1. For example, artificial intelligence (which comprises a set of smart technologies that can learn from their environments and take autonomous action) is fueled by rapid advances in neural networks and silicon level technology, the aggregation of storage in massive data centers, as well as a host of other symbiotic advances.7

These combinations of digital technology are usually complex and non-linear. When they are applied, unanticipated interactions often occur, either good or bad. Similarly, a technology that seems neither viable nor commercially useful can surprise incumbents by taking off abruptly when the stars align. Honeywell, for example, was blindsided when Nest Labs came out with a sleek Internet-enabled unit which allowed harried commuters to remotely ensure that the house would be warm and lit when they arrived. Nest had been working on this convergence of technologies for years, often secretly and away from the prying eyes of rivals. Despite a long incubation period, some digital technologies can ignite very rapid change when everything falls into place. Honeywell eventually caught up with Nest, but it lost three years by missing the moment.

No single technology creates turbulence on its own. Rather, the upheaval stems from the simultaneous maturing and intersection of several symbiotic technologies, engendering sharp declines in cost, new functions, and shared platforms to put them to work.

Figure 1: Many Combinations of Digital Capabilities

No single technology creates turbulence on its own. Rather, the upheaval stems from the simultaneous maturing and intersection of several symbiotic technologies, engendering sharp declines in cost, new functions, and shared platforms to put them to work. The turbulence in the relevant markets is intensified by the unpredictability of these processes. One such intersection is biometrics - the use of iris scans, along with face, voice, and fingerprint recognition to securely verify an individual’s identity. These systems are enabled by advances in mobility (smartphones with fingerprint scanning or facial recognition), artificial intelligence (to learn behavioral patterns), and the Internet of Things (a broad range of computing devices embedded in everyday objects). These creative combinations pave the way for even more advanced biometric applications, ranging from authenticating travelers and tracking medical data to screening...
those entering stadiums and theaters.

A creative combination of digital technologies, drawing on the expertise of apparently unrelated sectors, can also spark innovation. When Callaway began designing its latest line of golf clubs, it combined advances in artificial intelligence, machine learning, and computer-aided fabrication to generate the best product designs. Where the designers had previously been limited to trying five to seven physical prototypes from crafted designs, digital technologies allowed them to create 15,000 virtual prototypes. An algorithm then helped to select the best design based on performance parameters such as balance, ball speed, and trajectory, all the while conforming to the requirements of the U.S. Golf Association. The result was an award-winning design called the Epic Flash which helped many amateur players achieve longer drives.

Algorithmic design is likely to transform other sectors as well, enabling the rapid testing of many design options according to user-determined performance objectives, materials, budget restrictions, and aesthetics. It also suggests the possibility of hyper-personalized designs for products ranging from furniture to automobiles, all ordered up as readily as bespoke clothing. Vigilant firms will be at the forefront of such markets. Yet they must still be alert, lest their virtual designs lose touch with customer needs, and designers become mere custodians of an opaque digital process.

Most leadership teams recognize that they are in the midst of digital turbulence. Yet they also tire of generic warnings of impending disruption and wonder, ‘OK, but what should we do about it?’ Generic warnings do not help them to anticipate what lies around the corner when:

- Digital platforms help new global players to emerge unexpectedly. China now has a considerable lead in processing mobile payments (roughly fifty times that of the U.S.). In just fifteen years, the number of Chinese firms in the Fortune Global 500 has increased by more than twenty times.

Market boundaries are blurring and dissolving... This week’s competitor may become next week’s supplier, customer, partner, or all three. Although Apple and Samsung compete fiercely in the mobile phone market, Apple at the same time relies on Samsung for key phone components.

- Market boundaries are blurring and dissolving. “Fintechs,” or financial technologies, are changing not only how customers conduct transactions and secure loans, but also the nature of money itself. Some countries (like Bermuda and Switzerland) and companies are making big bets on cryptocurrencies, rooted in blockchain technology, which decentralize electronic exchanges of value and may hasten the obsolescence of cash. Business ecosystems are becoming more complex and difficult to navigate. This week’s competitor may become next week’s supplier, customer, or partner, or all three. Although Apple and Samsung compete fiercely in the mobile phone market, Apple at the same time relies on Samsung for key phone components.

- The pace of change keeps accelerating and traditional, hierarchical organizations are harder and harder pressed to keep up. In just two years, the Chinese video app TikTok, which supports the creation, sharing, and finding of short music videos, became one of the most downloaded mobile apps, just behind Facebook.

Meanwhile, organizations also grapple with continual changes in the requirements of stakeholders and customers, the strategies of competitors, the availability of talent and other resources, and the political and regulatory environment.

Because of the uncertainty of digital advances, our vision of the future may rest on unexamined and misleading assumptions. For example, the rapid acceptance of social media platforms conveniently obscured privacy concerns. Only with the 2018 Cambridge Analytica scandal—in which Facebook was revealed to have shared profiles without user permission or knowledge—did it dawn on people that their intimate digital data was being passed around in ways they never intended. As Sheryl Sandberg, Facebook COO, later admitted, “we were too slow to spot this and too slow to act. That is on us.”

It is ironic that digital innovators and data masters such as Facebook or Google failed, themselves, to be vigilant about broader societal issues or consumer reactions. It can be dangerous for companies to assume that an advance which improves their services or products will necessarily satisfy customers. Facebook, Google’s search engine, and Intuit’s Quicken all created customer value by being easy to use, saving time, reducing risk, and improving productivity. But such technologies can carry unintended consequences or blind spots.
false alarms which preceded them. That boy had cried wolf before. By the time hackers discovered how to invade the entire system and seize sensitive customer data, the overload of misleading warnings had lulled frontline computer analysts into dangerous complacency.

Advances in digital technology can also accidentally nurture internal problems and allow them to fester out of sight. Customer service personnel at Wells Fargo secretly created over two-million unauthorized accounts using digital methods and existing customer data. The scheme continued for years until, by the end of 2019, the bank was facing civil and criminal suits approaching $3.0 billion. Before the scandal ran its course, Wells Fargo fired 5,300 employees, including the CEO. At its root, the fraud succeeded because the bank’s systems allowed customers to open accounts without going to a branch or providing an ink signature. Tellers, agents, and even automated systems, could therefore create what appeared to be legitimate accounts, selecting a “no statements” option so the new stealth accounts would not announce themselves.

But the digital sword is two-edged and can sometimes be turned on itself, fighting fire with fire. The problem of excessive cybersecurity alerts is being partially solved using artificial intelligence that filters out false alarms, allowing technicians to concentrate on genuine warnings. An Alphabet offshoot called Chronicle, for example, helps organizations to defend against cyberattacks before they can reach internal networks and cause harm. Still, cybersecurity is likely to remain a cat-and-mouse game, and the computerized cats will have to become more aggressive. Vigilant leaders who wish to protect their business interests will have to learn how to harness new digital security capabilities.

Advances in digital technology can also work to the advantage of established players in other ways. Although a single blog post can shatter consumers’ confidence in product quality, social media also allows direct connections with customers and can provide timely warnings when errors occur. Similarly, low-cost digital competitors may emerge from unexpected sectors or geographies, but their entry is often signaled by social media activity. Vigilant firms detect these early warning signs sooner, which gives them extra time to respond to new entrants.

Navigating Digital Turbulence with Vigilance

Why are some firms adept at anticipating the opportunities and threats of digital turbulence, while others struggle to keep up? Our research shows that those who succeed have developed superior vigilance which they routinely exercise through deeply embedded organizational processes. While any organization can be blindsided at times, vigilant firms respond better. They know that thinking “it will never happen to us” is a false comfort. They may also know that weaker competitors are more vulnerable; as the joke goes, “I don’t have to outrun the bear…I just have to outrun you.” Strategic leaders in vigilant firms keep three navigation principles always in mind:

As Nobel Laureate Herbert Simon wrote in 1971, “[A] wealth of information creates a poverty of attention. More information is not always a good thing if it leads to blinkered thinking and analysis paralysis.”
Navigation Principle 1: Paying attention is deliberate. Vigilant organizations carefully discern which of a bewildering array of external and internal information to attend to, and which to ignore. They know that attention is the scarcest of all organizational resources and how it is used is vital to understanding and responding to an array of pressing issues each day. Struggling to pay attention to everything produces much the same results as paying attention to nothing. As Nobel Laureate Herbert Simon wrote in 1971, “[A] wealth of information creates a poverty of attention. More information is not always a good thing if it leads to blinkered thinking and analysis paralysis.”

So, how should leaders allocate their organization’s limited attention and their own? In vulnerable firms, leaders direct most of their attention toward current operations in an effort to meet short-term goals. Their scarce remaining time goes to unexpected events, unwelcome surprises, or internal political tensions. Such leaders seldom have time left to scrutinize the big picture and discuss the future. In consequence, their response to unexpected change tends to be weak, fragmented, and rushed.

When Alan Mulally took over as the CEO of Ford in 2006, the survival of the company was in question. It had lost 25 percent of its market share in seven years and was hemorrhaging cash. One of Mullaly’s first moves was to bring candor and vigilance to the senior leadership team’s Thursday morning meetings. Previously, those weekly meetings were reputed to be like combat zones, with executives scrutinizing one another for any vulnerability and focusing on self-preservation rather than collaboration. Their presentations were carefully vetted and rehearsed in advance, to avoid surprises.

Mulally started each meeting by inviting senior executives to share their internal problems and describe any anomalies they had noticed outside the company. What troubles are you facing? What puzzles you and why? What does it mean for the company and what can we do about it? His frank approach altered the tone of the meeting so completely that at first, no one volunteered any external stirrings that puzzled them. As Mulally persisted in searching for obstacles and anomalies, candidly sharing his own concerns, he pushed the team to widen their perspective and expand their views. Over time, they become completely honest about their own experience and more open to outside ideas.

Mark Fields, who succeeded Mulally as CEO, noted that, in the old Ford culture, talking about problems was viewed as a sign of weakness. Mulally challenged this macho view, redefining discussing problems and admitting collective ignorance early as signs of strength which allowed leaders to tackle potential upsets in a timely manner. This profound change in perspective paid off for Ford. When Alan Mulally came on board in 2006, the company was facing $17 billion in losses. Three years later, the company proposed a financing plan which netted it $23.5 billion in new loans, a clear sign of Wall Street’s confidence.

Navigation Principle 2: Adopt a new perspective about speed. Once organizations can sense incipient change and are beginning to understand what it might mean, they need to decide what action to take. In the maelstrom of digital turbulence, speed is a useful creed, but haste is not. Delays tend to increase the damage and narrow the range of opportunities available. The sooner the company spots the situation, the more time it has to create strategic options which it can then exercise when the time is right. This extra planning time helps in avoiding hasty and irreversible investments, and in reaping the competitive benefits of moving first, whether to establish a preemptive position or forestall a snowballing scandal. Just because the clock of business is whirring faster, doesn’t mean leaders need to operate in haste. Being faster to act than rivals is about being ready for action at all times, and the first step is early detection and understanding by means of probing questions and exploratory forays. Only through clarity can leaders orchestrate the multiple options and contingency plans which comprise organizational preparedness. The aim of early detection is to avoid being boxed in by the actions of rivals and ensure broad flexibility later, when circumstances call for quick or bold action. The upshot is that managers can act on their own terms rather than being forced to react to someone else’s initiative.

Navigation Principle 3: Vigilance fosters agility. Organizations at the bleeding edge of digital turbulence are moving from a comparatively comfortable and familiar risky environment (where goals can be specified, and probabilities calculated) toward the deep uncertainty of unknown unknowns. As Peter Drucker put it, we can navigate familiar environments by doing things right, whereas in turbulent times we must do the right things. So relying on our ordinary capabilities to efficiently carry out current processes, supply chain management, routine transactions, and delivering reliable performance, is not enough when digital disruptions strike. To navigate their deep uncertainty, managers require the tools of vigilance, rooted in three dynamic capabilities: sensing change early, seizing strategic opportunities at the right time, and transforming the organization so that it stays ahead. Companies which master these three skill sets, and adroitly use the organizational systems that support them, can become truly vigilant.
Which of these supporting abilities managers should emphasize most depends greatly on the situation. In exploring alternative energy sources that would make the best use of their biotech expertise, DuPont had many high-risk, capital-intensive opportunities to consider. Mastery of real-options analysis thus became an essential capability for the company. Meanwhile, organizations deploying widely available digital technologies, requiring smaller investments in tighter time frames, require different competencies. When Novartis equipped its sales representatives with interactive digital devices, so they could engage in consultative dialogues with prescribing doctors, it relied on highly tuned vigilant learning. In each of these different cases, at least six supporting capabilities were deployed, ranging from peripheral scanning and real options analysis, to organizational redesign and changes in company culture, with the importance of each varying according to their circumstance.

With the right set of dynamic capabilities in place, an organization becomes agile amidst high turbulence. Agility here means the ability to quickly and adroitly move resources into higher value activities before rivals do. Agile strategies are used to form a temporary “scrum” team to tackle an emerging opportunity or address a sudden threat. A small team of three to nine people with the diverse skills needed for each issue or project can be quickly assembled. These self-managing teams follow a transparent process, using design thinking to develop and test prototype solutions, learning rapidly as they go. This approach is the antithesis of traditional, cumbersome, top-down innovation processes which require repetitive meetings, extensive documentation, and myriad other bureaucratic impediments.

Future Shock is Still Here

Few people are adept at seeing around the next corner, and even fewer know what to do about what’s coming. Alvin Toffler was an exception. In 1970, he predicted that the accelerating pace of society’s change would initially be disruptive before becoming normal, and would continue to intensify. Toffler labeled this, “future shock…a dizzying disorientation brought on by the premature arrival of the future” and characterized by “confusional breakdowns” in every structure of society. Nearly fifty years later, it is no longer the premature arrival of the future that sickens executive teams, their boards, investors, and society: it is their own belated responses to that arrival.

The business leadership challenge of the future will be to blend big data, machine learning, human judgment, and artificial intelligence to create viable and evolving competitive advantages — and to do it in a way that is proactive, not reactive. By building an enhanced capacity for vigilance, leadership teams can stay alert, ready to anticipate potential threats and opportunities, and able to confront a fast-forward digital reality.

Acknowledgments:

We received valuable feedback on earlier drafts from Kirsten Sandberg.

Endnotes

1. Portions of this article have been adapted from their book, See Sooner/Act Faster: How Vigilant Leaders Thrive in an Era of Digital Turbulence, MIT Press (2019).


20. Alvin Toffler, Future Shock (New York: Bantam Books, 1971). He defined future shock as “the distress, both physical and psychological that arises from an overload of the human organism’s adaptive systems…the human response to over-stimulation.”
What Evolutionary Biology Can Teach Us About Corporate Reputation

Paul A. Argenti
The Tuck School of Business,
Dartmouth College

Ryan Calsbeek
Department of Biological Sciences,
Dartmouth College

Paul Argenti and Ryan Calsbeek of Dartmouth explain that corporations should focus not on their rankings, but on the attributes that influence those rankings. They combine evolutionary biology and corporate reputation research to determine what makes a company the best that it can be, arguing that a more scientific approach to corporate success is needed.
We have known for many years that intangible assets, such as brand and reputation, are among a firm's most valuable possessions. Yet firms have historically measured those assets by focusing not on the attributes upon which a corporation's reputation is built, but on external rankings like Fortune's Most Admired, Interbrand's brand rankings, and Harris Poll's Reputation Quotient. While rankings can provide valuable benchmarks, they reflect backward on what has already happened and offer no guidance on how to influence future reputation. Focusing on contributing factors means understanding the specific attributes that make companies great competitors—revealing the real story behind those rankings.

That's where evolutionary biology can help.

Evolutionary biology is, at its core, the study of optimization. Evolutionary biologists seek to understand which combination of traits makes some individuals better competitors than others. The traits that make a great competitor change with time and environment, so a species must evolve to stay competitive as its context changes. Consider Darwin's finches in the Galapagos. On dry islands, where hard nuts provide the only available food, they evolved with stout, powerful beaks. But on islands soaked with rain they evolved with long, narrow beaks good for extracting delicate, soft seeds. Neither bird can eat or survive in the other's environment. The birds that survive best in a given environment are more likely to pass their successful beak genes on to their offspring. This simple “variation-selection-inheritance” relationship determines the path of evolutionary change. Much like biological organisms, corporations need to evolve to survive and thrive. And context matters, just as it does with biological organisms.

Competitive environments determine which combinations of attributes will make the most successful corporate competitors.

Links between evolution and corporate competitiveness were first made decades ago. Nelson and Winter explored how biological processes could predict the winners and losers in a competitive marketplace. They studied how variations between firms caused some to perform better than others. Successful variants are "selected," meaning that a firm's successful attributes are retained in the marketplace, driving economic evolution. New variation is introduced by innovation while existing successful variation spreads by imitation. Lande and Arnold went on to lay out the mathematics of adaptation, revealing how and why specific combinations of attributes made some individuals better competitors than others.

Firms that compete in multiple contexts can borrow the outcomes-based approach of evolutionary biology to determine how to manage both their resources and such intangible assets as reputation.

So far, the corporate sector has paid little attention to the attribute-based view of selection and evolution. Instead, companies continue to rely heavily on surveys and social science analytics, restricting their ability to measure and understand how different combinations of attributes contribute to their tangible and intangible value. Firms that compete in multiple contexts can borrow the attribute-based approach of evolutionary biology to determine how to manage both their resources and such intangible assets as reputation.

This approach takes into account another challenge faced by both biological organisms and corporate firms: different competitive environments inevitably favor different attributes. Picture a landscape of hills and valleys. The hilltops represent adaptive combinations of a firm's attributes, such as employee, customer, and shareholder satisfaction, while the valleys reflect unsuccessful combinations. On this landscape, gains in elevation represent improved performance, with performance including any tangible or intangible asset gain. A firm may find that it needs to make only small improvements to particular attributes in order to adapt locally (e.g., within its industry) but to reach the peak of a distant hilltop (e.g., competitive dominance in the Fortune 100) it must make larger changes to more attributes. Traditional analytical approaches are no help here, because they cannot measure the costs and consequences of competition in different competitive environments.

We founded Revolution Insights Group to help companies use advances in evolutionary analytics to identify the most effective ways to adapt and excel in a competitive landscape. The set of models we have devised allows us to statistically compare the peaks and valleys of these rugged corporate adaptive landscapes. We arrange aggregated data from a variety of perspectives (e.g., employees, customers, shareholders, communities, and the environment) for hundreds of companies over a period of years in matrix form. Next, we apply a tensor decomposition, a mathematical technique that finds the key axes of variation that determine which attributes form hilltops and which form valleys. Our approach is the first to produce a rigorous understanding.
of which outcomes the corporate evolutionary process favors. We can then pinpoint, in various contexts, the precise areas in which a firm is performing weakly compared to its competitors.

When it comes to measuring and managing intangible assets like reputation, zeroing in on your company’s adaptive attributes—those that differentiate great firms from the rest—can be transformative.

When it comes to measuring and managing intangible assets like reputation, zeroing in on your company’s adaptive attributes—those that differentiate great firms from the rest—can be transformative. As Porter, discovered, deciding what exactly should be improved is often confusing to companies crafting a new strategy. While some attributes (like high-quality products and services) are obvious, adaptive differentiators will set a firm apart, pushing it to the top of the corporate landscape.

Imagine understanding the key attributes that define being the best in your industry. Now extend that understanding to your geographic region of interest or to the Fortune 500. Some of these attributes will be constant, while others will differ from one domain to the next. Either way, knowing in exactly which of dozens of attributes—including employee satisfaction, customer loyalty, environmental impact, and financial performance—you lag behind the competition, and by how much, is the foundation on which you can build your company’s reputation. No conventional ranking delivers anything like this level of specificity or utility.

Every company’s reputation is complex—a shifting tapestry of the perceptions of its disparate constituencies. You can certainly control the names, symbols, brands, and corporate character that you present, but these groups perceived them through a complex set of interactions that ultimately determines reputation. That complex set of interactions can now be measured through a rigorous and scientifically-vetted framework designed to handle large amounts of data. The dynamic nature of managing intangible attributes requires a continuous series of analyses which allow firms to adjust as perceptions shift.

We tested our dynamic approach on a global technology company that wanted to understand why, by internal measurements, its reputation was declining. Its executives had built the existing management framework on their own instinct that customer satisfaction was the most important component of a strong reputation. Our analysis revealed that, in fact, the leading companies in their field were focused first on employee satisfaction, a factor that wasn’t even on this company’s radar until our scientific approach brought its importance to light. The firm had put tens of millions of dollars into measuring customer satisfaction, when the real issue was essentially an HR problem. The firm was outperforming its competitors in customer satisfaction, but lagging behind on employee happiness. Excellent customer service may not have been hurting the firm but it also wasn’t an area in which additional gains provided further value. The solution wasn’t for the company to start ignoring its customers, but rather to understand that, by increasing its focus on employee satisfaction, it could improve interactions with customers, optimize its reputation, and increase sales.

Two other companies, one a large manufacturing company, had each made significant technological advances in their industries. Recognizing the strength of reputation enjoyed by many tech companies, each wanted to know how it could reposition itself to look more like tech companies. One of the companies was developing specialized software for one of its products while the other, like many companies today, just wanted to understand how repositioning might enhance its reputation. Our analytical approach allowed us to compare the attributes that contributed to adaptive combinations in the fields in which these firms had an interest (e.g., manufacturing vs. technology). By comparing the key attributes of each company to those of competitors from the tech sector, we revealed that the attributes which make great tech companies (innovation, environmental sustainability, employee diversity) were very different from the key attributes of their own industries (breadth of market reach in one case, quality of products and services in the other). Both companies found attributes they could adopt from the tech sector, focusing on diversity and innovation to improve their reputations.

An evolutionary approach—designed to reveal all of the independent variables that drive adaptation in a range of competitive environments—surpasses traditional social science methods and helps you devise a richer, more practical approach to managing your company’s intangible assets.
These examples demonstrate the folly of clinging to survey-based reputation management. An evolutionary approach—designed to reveal all of the independent variables that drive adaptation in a range of competitive environments—surpasses traditional social science methods and helps you devise a richer, more practical approach to managing your company’s intangible assets.

The time has come for companies to use scientific methods to measure and nurture their reputations. Their ability to adapt to the changing needs of their constituents in the 21st century depends upon it.

Since 1977, Paul A. Argenti has taught and conducted research on general management, corporate communication, corporate responsibility, and healthcare management at the Harvard Business School, the Columbia Business School, and Dartmouth’s Tuck School of Business, where he is currently Professor of Corporate Communication. With Dr. Calsbeek, he founded the Revolution Insights Group in 2016. info@revolutioninsightsgroup.com

Dr. Ryan Calsbeek is an evolutionary biologist and Associate Professor of Biological Sciences at Dartmouth College. Co-founder of Revolution Insights Group, Calsbeek was previously a research fellow at the National Evolutionary Synthesis center and a visiting professor at Université Pierre et Marie Curie, Paris, France.

Endnotes

4. Wagner, K. The ‘Stories’ product that Facebook copied from Snapchat is now Facebook’s future. Vox Recode, 2018.
This award is named for Internet pioneer Leonard Kleinrock. By contributing to the development of technologies that now underpin most networked data transmissions, including the Internet, Kleinrock is a co-creator of one of the greatest inventions in human history.

In 1988, Kleinrock chaired the National Research Council’s Network Review Committee, whose report informed the 1991 High Performance Computing Act which dramatically improved computer network infrastructure across the U.S. and paved the way for the Internet’s current ubiquity. For more details on Dr. Kleinrock’s extraordinary career and accomplishments, see the laudation on the next page.

Through his elite research and determination to translate that research into practical innovations which have enormously benefitted the world, Kleinrock exemplifies the aspirations of MBR. We hope the papers honored with this award will fulfill these aspirations by bringing management research and practice together to serve the needs of humanity.
Leonard Kleinrock
Internet Pioneer

Dr. Morten Bay
USC Annenberg School of Communication
The emergence of the Internet has profoundly affected our existence and the world we live in. Rooted in the efforts of a small group of people who had a vision and performed the intense labor necessary to realize it, the Internet has grown into a technological movement born of the collaborations of its contributors. One of those essential early figures in the Internet’s history is Leonard Kleinrock. Morten Bay describes Kleinrock’s remarkable life and career as a co-creator of one of the greatest inventions in human history.

The Internet has profoundly affected our existence and the world we live in. Despite its dark corners and inequities, the Internet has mostly been a benefit to humanity, allowing information to instantly travel further than any technology before it, creating new economic opportunities, and bringing people together into a truly global community. Its advent has justly been compared to that of Gutenberg’s printing press, which also made knowledge cheaper, faster, and easier to distribute, while creating new markets and increasing the awareness and education of people who had previously had limited access to such resources.

The Gutenberg press ushered in the Renaissance, a transitional moment in history which shaped the world for hundreds of years. Yet those who led that charge were probably unaware that their actions would resonate through the centuries. Our current perception of the Internet’s impact is probably a similar underestimation. Perhaps fifty years from now, when the Internet has seen its first century, the resemblance between its effects and those of the Gutenberg press may be clearer to us. From that future vantage point, we should be able to truly recognize how the Internet accelerated decisions in business and politics and how it transformed exchange, distribution, and the sharing of goods and resources.

We may also look back and see how, this year, for the first time in human history, a pandemic did not stop the world in its tracks. Although the consequences of COVID-19 have been devastating, business, education, healthcare, government, and simple socialization, albeit without physical proximity, continued. Life continued. And it was in large part because of the Internet. This astonishing and diverse global network kept millions of quarantined people from losing their minds out of boredom and isolation.

The modern Internet is a technological behemoth born of the collaborations of thousands, if not millions, of contributors and active participants. But like the Renaissance, it began with a small group of people who thought just a wee bit ahead and devoted themselves to the intense labor of realizing their vision. Leonard Kleinrock is one of those people.

Dr. Leonard Kleinrock was born in New York City on June 13, 1934. As a child, he visited the 1939 World’s Fair and was enthralled by the many visions of future technology on display. A year later, the young Kleinrock built the first
of his many electronics projects, a crystal radio constructed from abandoned equipment and scraps of older radios. Already, it was clear that his future would involve technology. Kleinrock graduated from the Bronx High School of Science in 1951. While working during the day, he spent his evenings among former college dropouts, G.I. Bill veterans, and driven but underprivileged youngsters like himself. He was pursuing an electrical engineering degree at the City College of New York. Having been graduated from CCNY in 1957, Kleinrock received a full scholarship to the Massachusetts Institute of Technology (MIT) where he earned a master’s degree in 1959 and a Ph.D. in 1963, both in electrical engineering. His doctoral committee included Dr. Claude Shannon, famous for his groundbreaking work on information theory and mathematical theories of communication.

Kleinrock contributed to the development of technologies that now underpin most networked data transmissions, including the Internet.

While at MIT, Kleinrock worked with a group of doctoral classmates which included fellow computing and Internet pioneers Lawrence Roberts and Ivan Sutherland. All three used the large TX-2 computer at MIT’s Lincoln Laboratories and, in this common work environment, forged a lifelong bond of friendship. Kleinrock developed a mathematical theory of packetized data in networks for his doctoral dissertation. He expanded upon queuing theory to explore ways to model, analyze, and optimize these data networks. Most vitally, he realized that routing data through fixed network paths, the default method used in the telephone system of the time, was inefficient, since data were transmitted in bursts. Instead, he proposed a routing concept in which network resources could be shared and allocated on demand. While exploring ways to route messages more efficiently and reliably, Kleinrock struck upon the idea of splitting them up into smaller blocks of data that could be routed independently through any available network connection and reassembled upon arrival. He evaluated the performance gains of packetization, providing a mathematical foundation for the technology which now underlies nearly all networked data transmissions and supports the Internet as we know it. Kleinrock’s dissertation and its related publications elaborated upon his theory and proved that his system would be more efficient and reliable than most routing methods then available. In 1964, Kleinrock published this and other concepts in communication network theory from his dissertation in Communication Nets – Stochastic Message Flow and Delay from McGraw-Hill.

Kleinrock was instrumental in bringing packet switching to the network, one of the decisions that made ARPANET a stunning success.

By that time, Kleinrock had joined the faculty at the University of California Los Angeles’ Department of Computer Science. In 1967, the Defense Advanced Research Project Agency, or DARPA (then ARPA), tasked Lawrence Roberts with planning and managing the construction of ARPANET, the world’s first network of heterogeneous computers. Roberts brought Kleinrock on board, the two of them having worked together since the MIT days. Kleinrock was instrumental in bringing packet switching to the network, one of the decisions that made ARPANET a stunning success. The network quickly spawned a plethora of copycat networks which would eventually come together into the Internet we now know. Kleinrock personally oversaw ARPANET’s first connection on October 29, 1969, when a Sigma 7 computer at UCLA logged on to a PDP-1 computer at the Stanford Research Institute. In subsequent years, Kleinrock led the team which meticulously analyzed and measured the nascent network’s efficiency and function. Throughout the 1970s, their work produced a host of groundbreaking research publications and important advances in computer science. Several graduate students who passed through Kleinrock’s ARPANET lab at UCLA became Internet pioneers in their own right. Among them are Vint Cerf, co-author of the TCP/IP protocols, Steve Crocker, who invented the Request for Comments series, and Jon Postel, who pioneered the global allocation of IP addresses.

In 2018, Kleinrock revisited and extended a 1979 paper, introducing the concept that power is the key metric when optimizing flow in packet networks. The paper presented a better approach to TCP/IP congestion control and persuaded Google to adopt the power metric when it redesigned the YouTube network. Kleinrock also introduced the innovative concept of nomadic computing in a 1995 paper. He has received countless awards and accolades, including the National Medal of Science (2008), The National Academy of Engineering’s Charles Stark Draper Prize (2001), The Marconi Prize.
In 1988, Leonard Kleinrock chaired the National Research Council committee upon whose report then-Senator Al Gore based his 1991 High Performance Computing Act. The resulting bill dramatically improved computer network infrastructure across the U.S. and paved the way for the Internet’s current ubiquity. While continuing his professorship at UCLA, Kleinrock has founded several successful companies. One of the first was Linkabit, founded with Dr. Andrew Viterbi, then a colleague at UCLA, and Irwin Jacobs. Viterbi and Jacobs went on to found Qualcomm. Kleinrock also founded Nomadix, Inc., which produces network gateway equipment. He currently leads TTI/Vanguard, another of his companies, which provides a membership-based forum for high-level executives in the technology industry. Kleinrock is now a distinguished professor emeritus at UCLA which, in 2020, awarded him the UCLA Medal for his service to the university, an institution to which he has devoted himself for more than five decades.

Dr. Morten Bay is a research fellow at the Center for the Digital Future at USC’s Annenberg School of Communication, where he also teaches. He has written three books, many research papers and countless news articles about Internet ethics, socioeconomic effects of technology, social media politics, and Internet history.
George Bernard Dantzig:
The Pioneer of Linear Optimization

John R. Birge
University of Chicago Booth School of Business
George Bernard Dantzig (1914-2005) introduced the world to linear programming and, more generally, to the power of optimization. His work created trillions of dollars of value and preserved countless years of life across the globe. By creating the simplex method for solving linear programs he made vastly complex decisions amenable to computation. By demonstrating the duality between activities and prices he paved the way for new analyses resulting in greater market efficiency. His work has supported growing economies and improved healthcare, saving many from hunger and extending lives around the world. Dantzig's optimism and determination inspired many to increase their own achievements.

Dantzig became interested in mathematics as a child, although his parents, Tobias and Anja, had named him after George Bernard Shaw in the hope that he would become a writer. His father, a mathematics professor at the University of Maryland, gave George “thousands of geometry problems” that fascinated him and honed his powers of analysis. After earning an undergraduate degree in mathematics and physics at Maryland, Dantzig went on to pursue graduate studies in mathematics at the University of Michigan. Finding the program’s focus on abstract mathematics uninspiring, he left Ann Arbor and returned to Washington to work at the Bureau of Labor Statistics (BLS). His new profession prompted him to begin working on practical applications of mathematics. As he often remarked later in life, his many mathematical discoveries, while sometimes stated abstractly, were all inspired by practical problems facing firms, organizations, or governments.

After a few years at BLS, Dantzig found new inspiration for research in the work of Jerzy Neyman at the University of California, Berkeley. The real tale of Dantzig’s world-changing career and professional fame began with the now-legendary moment when he arrived late to Neyman’s class. In previous weeks, Neyman had customarily written the week’s homework problems on the board at the beginning of the period. So when Dantzig saw two problems on the board, he wrote them down to work on and hand in before the next class session. He found the problems a bit more difficult than usual and was a few days late in completing them. He took his solutions to Neyman’s office to ask the professor if he still wanted to review the homework. Neyman told him to leave them on his desk, which was so covered with papers that Dantzig feared his hard work would be lost forever.

Dantzig heard nothing from Neyman for several weeks, but then he was awakened early on a Sunday morning by the sound of vigorous knocking on his downstairs door. When he answered, Neyman abruptly informed him that his dissertation was done. The two problems Dantzig had solved for homework were actually two famous unsolved (and until then, unsolvable) problems in statistics. Dantzig’s unshakeable belief that he could solve the problems has become a symbol of the power of positive thinking. His story continues to inspire others to undertake difficult tasks.

As well as offering a stunning example of individual achievement, Dantzig’s solutions of the ‘homework’ problems laid the groundwork for the beginning of linear programming and countless subsequent applications. While working for the U.S. Air Force during and after World War II, Dantzig began to see ways to improve its efficiency. He sought to automate the planning or programming process of delineating detailed requirements for producing, assembling, training, and locating all of the military’s personnel and equipment. He developed a model for finding the best combination and levels of activities and uses of resources which became known as linear programming. Its solutions were provided by
the pioneering algorithm inspired by his dissertation: the simplex method. Fortuitously, his development of this numerical procedure coincided with the advent of computers and contributed to their development as well.2

Linear programs and Dantzig’s many other contributions to optimization have driven enormous increases in productivity throughout the global economy.

Linear programs and Dantzig’s many other contributions to optimization have driven enormous increases in productivity throughout the global economy. Industries with expensive capacity or limited production flexibility, like airlines, hotels, rental cars, and many retailers, have used revenue management models, often built on linear programming, to achieve revenue increases of 5 percent or more. The electric power industry also uses advanced optimization methods to reap cost savings that exceed 5 percent of their overall energy. The logistics field has also benefited enormously from optimization, reducing shipping costs by up to 50 percent in many industries including retail, chemical, tech, and consumer goods. In addition, much of modern finance and asset management is built on Markowitz’s efficient portfolio model, which was rooted in Dantzig’s work.3 Combining these accomplishments with uses in telecommunications, manufacturing, and more, and particularly in complex process industries like chemical manufacturing, linear optimization probably contributes over 5 percent to the overall output, or about $1 trillion each year, in the US alone.

Linear programming has become a vital tool in advancing artificial intelligence and machine learning, and it is used in electrical stimulation therapy, chemotherapy plans, drug discovery, radiation therapy designs, and finding optimal diets.

Beyond traditional industrial uses, linear programming has become a vital tool in advancing artificial intelligence and machine learning. Such optimization procedures have not just reduced costs and increased outputs across the globe, they have also saved countless lives. Linear programming is used in the phylogenetic analysis that determines the origins of organisms (including viruses, such as SARS-CoV-2, better known as the novel coronavirus). It is also used in electrical stimulation therapy, chemotherapy plans, drug discovery, radiation therapy designs, and finding optimal diets, an application which has drawn interest for more than seventy-five years.4

Linear programming and its various extensions continue to play an influential role in the economy and in all our lives.

Linear programming and its various extensions continue to play an influential role in the economy and in all our lives. The simplex method is also a remarkable tool, named one of the top ten algorithms of the twentieth century and an indispensable part of optimization to this day. Dantzig’s other contributions constitute the foundation upon which the development of many other decision-making tools over the past seventy years was built. Nonetheless, as Dantzig himself was known to point out, his most fundamental contribution may have been the very concept of an objective function.5 As he wrote, earlier planners and managers may have shied away from the notion of optimizing an objective because they thought it inconceivable to find an optimal solution among possibilities more numerous than the atoms in the universe. Dantzig dared to conceive of surmounting that imposing obstacle and succeeded, to the substantial benefit of us all.

John Birge is the Hobart W. Williams Distinguished Service Professor of Operations Management at the University of Chicago Booth School of Business. His work follows that of his doctoral advisor, George Dantzig, in exploring ways to make better decisions.

Endnotes

The Singhal award’s purpose is to promote and recognize innovations in manufacturing and service organizations. By bringing these innovations to light so that other organizations can learn about them, we can have a positive impact on the world. Without this competition, many of these innovations would remain unknown. Companywide innovations as well as those in specific units will be considered. All organizations, private and public, profit and non-profit, from all over the world are eligible to apply for this award.

Kalyan Singhal is the Doris and Robert McCurdy Professor of Management at the University of Baltimore. Dr. Singhal founded the Production and Operations Management Society (POMS) in 1989. He also founded the society’s journal *Production and Operations Management* in 1992 and has since served as its editor in chief. Dr. Singhal is the publisher and coeditor in chief of the *Management and Business Review*. He is a fellow of INFORMS and POMS.

Dr. Singhal exemplifies the goal of this award, having pursued successful innovations in companies, conducted research which has produced innovations in both private and public sector organizations, and founded institutions and publications which have made enormous contributions to academia, business, and society.

Organizations competing for this award will be judged on the following criteria:

- Creativity and novelty of the system.
- Impact on the organization in terms of cost and quality of goods and services.
- Impact on employees, customers, and suppliers.
- Impact on society at large as measured through environmental, social, and governance criteria, particularly lives improved or saved.
- Organizational and technical challenges that were overcome in completing the project.
- Technical innovation.
- Portability to other applications or industries.

Candidates should be prepared to share the details and results of their innovations and to submit to verification of their reports.

Prizes and Plaques: The winning team will receive a $20,000 cash prize while up to five runners-up will receive $2,000 each. The winning organization and each of the finalists will also receive a plaque.

Application: Please submit a three-page summary (no more than 1,800 words) of what your company accomplished, including just enough detail that we can judge whether your work is appropriate for this competition. In addition, please submit a cover page with the title, authors’ names and affiliations, and a 100-word abstract of the achievement. Please submit this document electronically as a pdf file, using 12 point font, to: Professor Subodha Kumar at subodha@temple.edu. This application is due by September 25, 2021.

Reports: Entrants will be asked to report on a system which has been practically applied and to describe its significant, verifiable, and preferably quantifiable impact on the performance of the organization.

Presentation: Each finalist will have the opportunity to make a 40-minute presentation with Q&A at the April 2022 POMS annual conference. The presentation will be video recorded.

Publication of Articles: Each finalist will be expected to write a short article which will be published in *Management and Business Review*. In addition, any finalist team that writes a research paper, should submit it to the POMS journal *Production and Operations Management* for expedited review.
Artificial intelligence is the most important new technology of the age, but it comes in many varieties, and businesses face a range of challenges in effectively deploying it throughout their organizations. Tom Davenport takes a pragmatic but positive approach to AI’s long-term potential, describing effective approaches to creating and implementing a strategy for this transformative technology.

Artificial intelligence (AI), often defined as technology that performs tasks which previously could only be done by the human brain, is currently viewed as the new technology most important and disruptive to large organizations. Many companies around the world are now exploring or implementing it, with varying degrees of enthusiasm. There is now sufficient evidence through which to evaluate its initial impact on organizational strategies, business models, product and service offerings, and employment. Overall, its effects are incremental and in keeping with previous analytical efforts. However, there is every reason to expect more dramatic effects over the long term,
particularly on companies that decide to make extensive and ambitious use of AI.

Results from various surveys, most of them conducted by consulting firms, suggest that between 20 and 37 percent of large companies globally are either adopting or experimenting with AI. Market researchers have found that a larger percentage—perhaps as many as 60 percent of large firms—now employ robotic process automation, the easiest form of AI to assimilate. In many of these firms, AI, particularly in the form of machine learning, is used to extend business analytics. However, some forms of AI have different capabilities.

Technologies Adopted in the Enterprise

Artificial intelligence is not one technology, but several that are increasingly being used for specific applications. Three main resources underlie most AI, and they are employed in several different types of technology. These resources are statistical analysis, semantic or linguistic analysis, and logic, typically in the form of rules. Those tools support a variety of AI methods, which in turn drive AI applications (Figure 1).

AI Methods

Neural Networks, Deep Learning, Machine Learning—Machine learning is used to create computer systems that improve themselves through experience, which is often codified in the form of training data. The machine learns by devising the best ways of fitting models to the training data. A diverse array of learning algorithms and statistical techniques has been developed to cover the wide variety of data and problems used to teach machines. As noted by the eminent researchers and pioneers of machine learning Professors Jordan and Mitchell, “Many developers of AI systems now recognize that, for many applications, it can be far easier to train a system by showing it examples of desired input-output behavior than to program it manually by anticipating the desired response for all possible inputs.”

Over the past decade, machine learning has become one of the most commonly used forms of AI. A 2018 Deloitte survey of 1,100 U.S. managers whose organizations were pursuing AI found that 63 percent used machine learning. Indeed, the many forms of machine learning lie at the core of numerous approaches to artificial intelligence. In its most basic form, machine learning is synonymous with predictive analytics. Computers use models from data for which the results are known to predict the results from new data.

Figure 1: AI Tools, Methods, and Applications

In its most basic form, machine learning is synonymous with predictive analytics. Computers use models from data for which the results are known to predict the results from new data.
Some leading-edge vendor and user firms, though, are experimenting with models that learn continuously when new training data becomes available.

The neural network is more complex, a form of automated machine learning that has its roots in the 1940s and has steadily progressed ever since. Its developers made particular progress in the 1980s (with the invention of backpropagation, which streamlined the calculation of errors through multilayered neural nets and thus removed a major barrier to complex neural algorithms) and in the year 2012 (with the University of Toronto team’s victory at Stanford’s ImageNet competition for visual image recognition).

The most complex forms of machine learning involve deep learning, neural networks with many layers and many nodes per layer. These many layers permit the complexity of features or variables necessary to make predictions. Deep learning systems view problems in terms of inputs and outputs, and of the weighted variables or features that connect them. Thousands of hidden features may make up such models and are calculated by the extremely rapid processing of today’s GPU (graphics processing unit) and cloud architectures. Deep learning is often used in image recognition, although it can also be used to increase the precision of applications like fraud detection, which would otherwise use conventional machine learning. Although deep learning has been likened to the processing of signals by neurons, the analogy holds only at a high conceptual level, not in terms of the actual details of computation or execution.

Deep learning is also increasingly used for speech recognition and other language-based analysis. It has therefore become an important tool for language processing. Unlike earlier forms of statistical analysis, the individual features of a deep learning model have little meaning to a human observer, sometimes to the point of being impossible to interpret. As a result, highly regulated industries like banking, insurance, and healthcare find deep learning models problematic, though researchers are attempting to make them more transparent.

Rule Engines and Rule-Based Systems—Systems based on collections of if/then rules or those based on knowledge engineering, which tried to emulate human expertise, were the dominant technology for AI in the 1980s. They have since seen wide commercial use. Although these rule-based expert systems are no longer state of the art, one recent survey found that about half of large US firms still use them. They are quite reliable for tasks like insurance underwriting and providing clinical decision support in health care. These expert systems require human experts and knowledge engineers to construct a set of rules for each particular knowledge domain. The systems then perform their tasks well and are easy to understand. But when the number of rules grows, into the several thousands, and they begin to conflict with each other, these systems tend to break down. Moreover changing the rules as the field changes can be both difficult and time-consuming.

Natural Language Processing (NLP)—Making sense of human language has been a goal of AI researchers since the 1950s. This field, called natural language processing, includes speech recognition, text analysis, translation, and other tasks involving language. There are two basic approaches to NLP: semantic and statistical. Semantic NLP requires a graph or network of relationships between terms and phrases, which can be arduous to construct. It also requires the system to assess conversational intent. Semantic NLP is widely used for the intelligent automated agents in customer service and call centers.

Statistical NLP is rooted in machine learning (particularly in increasingly deep learning neural networks) and is responsible for the recent increase in speech recognition accuracy. It requires a large body of language from which to learn. Statistical NLP is widely used for applications like machine translation, where there is a great deal of available data with which to train models.

Applications of AI

Image and Speech Recognition—AI image and speech recognition have existed for many years, but new methods, particularly deep learning, have rapidly improved them. The accuracy of speech recognition in some applications is nearly 97 percent, while that of image recognition is well over the 95 percent that humans generally achieve. Both applications have improved considerably through the availability of large databases of speech and images.

Intelligent Agents and Chatbots—Hundreds of chatbots, intelligent agents, and intelligent assistants are now commercially available. They power smart speakers, smartphone assistants, and the basic interactions customers have with firms in a broad range of industries. Some employ standard rules and simple, natural language generators while others use sophisticated deep learning models. For standard transactions, they often augment human interactions, but they have only rarely replaced human agents in call centers.

Prediction and Classification Systems—Perhaps the oldest and most common form of AI is statistically based prediction or classification systems. Supervised machine learning, by far the most popular form in business, relies on data sets in which outcomes are used to train a model to predict or classify accurately.
These systems can then be used to score unknown results. While machine learning uses a variety of algorithms to predict or classify, in its simplest forms it is essentially indistinguishable from predictive analytical models, like credit scores, which have been used commercially since the 1950s.

Planning and Scheduling—Another enduring application of AI uses automated systems to achieve specific objectives in the physical or virtual world. Using methods that range from machine learning and reinforcement learning to rules or optimization techniques, these systems get autonomous vehicles to their destinations, manage workflow, or guide the actions of robots.

Intelligent Robots and Cobots—With almost 400,000 industrial robots installed globally each year, physical robots are well-known. In factories and warehouses, they perform defined tasks like lifting, repositioning, welding, or assembling objects. They distribute supplies in hospitals. Robotic mechanical arms, in concert with camera systems and other sensors, have been used in surgery for almost twenty years. Functioning under the guidance and control of a human surgeon, they are not technically speaking, autonomous robots, but rather remotely operated systems. Nonetheless, these machine appendages expand the powers of surgeons dramatically, improving their ability to see, create precise incisions, sew tiny stitches, and more. A new generation of robots, dubbed cobots, are even better at collaborating with humans and are easily trained simply by moving them through a particular task. As broader AI capabilities are added to their brains, that is, their operating systems, robots are becoming ever more intelligent.

Robotic Process Automation (RPA)—This technology inhabits the gap between AI methods and the use of other technologies, some AI-based, and some not. RPA digitally performs structured administrative tasks, using information systems, as if it were a human user following a script or set of rules. RPA is comparatively inexpensive, easy to program, and transparent in its actions. Its use is therefore growing very rapidly. The revenues of RPA vendors grew by 63 percent in 2018 and reached $1.3 billion in 2019. Robotic process automation is actually a misnomer, since it doesn’t involve any robots, only computer programs on ordinary servers. It relies on integrating workflow, business rules, and standardized data with information systems to act like a semi-intelligent user of the systems. In business it is generally applied to structured back-office processes including billing and customer service. When combined with other technologies, like image recognition, RPA can be used to extract data from, for example, faxed images and input them into transactional systems.7

While all these technologies are individual and separate, they can also be combined and integrated. Although they do not function like biological brains, AI is providing robots with brains in the sense that both cognitive automation systems and physical automation systems are becoming more capable, more adaptable and, in a limited sense, smarter. Machine learning-based image and text recognition are now being integrated with RPA. Perhaps in the future they will be so seamlessly integrated that artificial intelligence can be accurately discussed as a single technology. Today, however, the capabilities and applications of different AI technologies are sufficiently distinct that it is important for business leaders to understand the variations.

How Aggressively Are Large Firms Adopting AI?

If a company wants to use AI to create a competitive advantage, it must adopt the technology broadly and aggressively. Too often, companies create pilots or proofs of concept without planning how the technology will be deployed or fully understanding the depth and complexity of the process changes necessary to integrating it and realizing large scale benefits. Full production implementation of AI technology is relatively scarce outside of the largest and most capable firms, and for good reasons. One of these is the relative immaturity of the technology. Chatbots and intelligent agents, for example, are improving all the time, but they can still be an ordeal for customers and many companies hesitate to force them on their clients. Instead, companies ask their employees to use these applications in HR and IT, or make it easy for customers to opt out.

And if the AI requires changes to an existing process or new employee skills, that’s another barrier, since the company must devise a plan to manage those changes. Most AI systems still need to interact with human workers, and teaching those workers new tasks and skills can be time-consuming and expensive. Surveyed workers often feel they are not being effectively trained to work with AI.

To be used to full advantage, AI must also be interfaced with production information systems and architectures. A 2017 Deloitte survey found that the number one obstacle to the successful deployment of AI was that it was “difficult to integrate cognitive projects with existing processes and systems.” Even RPA systems, which are quite easy to set up for small volumes of robots, can become an architectural challenge when the volume increases. Moreover, because RPA applications act as users of production systems, they are sensitive to changes in those systems and may have to be reprogrammed.

The number of AI projects underway in a company serves as a
rough measure of the aggressiveness with which it is adopting AI. Of course, AI projects vary in scale and scope, and some projects call for several underlying AI applications. As AI matures and becomes more integrated into firms, the combined extent to which businesses have been successfully transformed may become a better measure of its use.

There are several ways for firms to count AI projects, and many do not have any accurate count, but in interviews with company executives I have been told that:

- Vanguard has only a few AI projects, in the single digits, but one with some AI is the very successful “robo-advisor” embedded in the company’s “Personal Advisor Services;”
- Intermountain Healthcare, a provider which has been quite aggressive with AI, has several dozen projects;
- Pfizer has over 150 projects in its pharmaceutical and life sciences business;
- Capital One, a pioneer in applying analytics to banking, has about 1000 AI projects; and
- Google/Alphabet had over 2700 machine learning projects in 2016 and has now stopped counting.

Clearly tech firms like Google are often the quickest and most successful at adopting AI. Facebook and Amazon, likewise, are known to have widely embraced it. Some banks, like Capital One, Bank of America, and JPMorgan Chase, have many AI projects underway as well. Yet other industries are only dipping their toes in the AI water or staying on the beach. Using the technology requires a fairly high degree of technical skill as well as a substantial amount of data, so business to business firms and small or medium companies are least likely to use AI.

**How Ambitious Should AI Projects Be?**

Surveys suggest that many executives feel that AI will have a transformative impact on their businesses and industries. In a 2018 global survey, Deloitte found that 57 percent of executives believed that AI technology would substantially transform their companies within three years, and 38 percent believed that their industries would also be transformed. While these numbers are lower (and perhaps more realistic) than those in Deloitte’s 2017 survey, they still suggest high expectations.

**Even at highly tech-oriented firms like Amazon, ambitious AI projects often fail or dramatically exceed their budgets and timelines.**

In order to fulfill those expectations, companies will have to enact large and highly ambitious projects. Early results, however, suggest that, even at tech-oriented firms like Amazon, ambitious AI projects often fail or dramatically exceed their budgets and timelines. Still, even companies whose grander projects have failed have succeeded with less ambitious ones.

How should organizations reconcile, then, their desire and expectation for AI to be transformative with the knowledge that simpler AI projects have a much higher success rate? One approach is to recognize the overall nature of AI, which tends to automate individual tasks rather than entire jobs or processes. Most successful AI projects will therefore be relatively small in scope. However, small projects can be combined to achieve greater impact. A company interested in transforming its customer experience could combine intelligent assistance and recommendations with customer feedback analysis. Together they might produce a noticeable improvement in customer experience.

Many companies say that their primary objectives with AI concern improvement or innovation in products and services. In 2017 and 2018 Deloitte’s surveys found that the most common anticipated benefit from AI, at about 50 percent, was “enhancing the performance of products and services.” “Creating new products” was chosen by about 30 percent of respondents and “pursuing new markets” by about 25 percent. Products and services, then, offer extensive opportunities for companies to add AI. These innovation-oriented objectives may diminish somewhat compared to operational improvements or cost reduction in a more challenging economic climate.

Given the desire and expectation of executives that their business will be transformed, companies should take a strategic approach to determining how AI fits in their firm. An approach that allows them to think big, but start small, is likely to produce a higher success rate than plunging in at the deep end. Senior executives should discuss all possible effects of AI on their business, and create a high-level model of how their AI strategy should evolve, as well as whether it will involve internal processes, external offerings, or both.

The most aggressive AI strategies can also change existing business models. The world’s most valuable companies today (Microsoft, Alphabet/Google, Facebook, Amazon, Alibaba, Tencent, Ping An) all have business models which are to some extent based on a digital platform. These platforms, which connect buyers and sellers, work effectively only because of machine learning. This technology allows massive platforms to connect the right buyer with the right seller and
recommend suitable products and services. Their success may entice other firms with an interest in AI to move toward platform business models powered by machine learning. While success would almost certainly raise their equity valuations, changing a company’s entire business model is complex and difficult, and adopting AI is a relatively small piece of the puzzle. Nevertheless, the employee benefits firm Benefit-Focus, has recently announced that it is enacting a “AI-driven platform pivot,” a multi-year, multi-faceted change program.

The Impact on the Workforce
One of the most common concerns about AI is that it will eliminate jobs. Yet so far almost none of the organizations in which I have conducted interviews have reported significant job cuts. Almost all say they are “freeing up human workers to do more creative or complex tasks” or something similar. Two technologies, though, have contributed to exceptions: industrial robots and robotic process automation. Two economists studied the impact of industrial robots on jobs. They found that, per thousand US workers, each robot replaced six humans and decreased wages by less than one percent.

Job losses from robotic process automation have yet to be accurately reported, but some companies do say they are planning or hoping to substantially reduce jobs. The Swiss bank UBS, for example, plans to use thousands of RPA robots to do work formerly performed by human office and information workers. Their stated goal is to reduce employment and thereby labor costs. A report created by the bank declared that the company is seeking cost savings through automation, and noted, “We make no secret that a certain portion of cost savings will come from reducing staff numbers.” Likewise, some offshore outsourcing firms have attributed their reduction of human jobs in offshore back office processes to RPA use by onshore clients.

Despite a few such admissions, though, there may be a conspiracy of silence around the topic of job loss due to automation. While many companies claim to be planning to augment their workforce with AI, rather than replacing it, there are signs that they too may instead be hoping that large-scale automation will allow them to cut human employment and save on labor costs. One report of unofficial conversations at the 2019 World Economic Forum in Davos suggests that executives privately hope and plan to cut jobs on a large scale. Similarly, a 2018 Deloitte survey of US executives familiar with their companies’ AI initiatives found that 63 percent agreed that, “to cut costs, my company wants to automate as many jobs as possible with AI.” Several vendors of AI technology have told me that, while they don’t talk about it publicly, their customers are intent upon using AI to eliminate jobs. It seems likely that any economic recession would lead to more substantial job and cost reductions from AI in its various forms.

This objective is not surprising in a capitalist society, and companies have used technology to automate jobs for centuries. However, if AI does eliminate a substantial percentage of jobs or exacerbate inequality, there may be a major backlash against the technology.

Key Trends in Enterprise AI
There are four current trends which are beginning to reshape the use of AI in large companies: embedding AI into transactional systems, democratization through automation, creation of AI centers of excellence and other management structures, and sparse data technologies. These innovations are easing what are now inherent necessities of using AI: integration with existing systems and processes, highly skilled technicians, special abilities in every business unit and function, and large quantities of data, respectively.

Embedding AI into Transactional Systems—Many of the AI systems on the market or developed from scratch by organizations solve relatively isolated problems and are therefore stand-alone solutions. In order to be effectively deployed in large organizations, they need to be integrated with existing systems and processes. To help meet that need, many software vendors are beginning to offer systems with embedded AI capabilities.

For example, if a company wants to qualify and rank its sales leads by predicted likelihood of purchase (typically through some combination of machine learning and natural language processing), it has two choices: it can develop its own AI application to predict and score leads, and then try to integrate it with its customer relationship management (CRM) system, or it can buy the same capabilities from an established CRM vendor. Salesforce.com, for example, includes some AI capabilities, under the title of Einstein, that are already integrated with transaction software. And the company continues to invest substantially in embedding more AI capabilities into its products. Several other vendors, including SAP and Oracle, offer similar products. By using an existing vendor, a company can use all the data collected by its enterprise software, and users don’t have to learn a new interface or system.

Companies are increasingly adopting their vendors’ embedded capabilities. In a 2018 survey of U.S. executives from companies already using AI, 59 percent said they were employing enterprise software with AI capabilities, making it the most popular means of moving into AI. And more companies will surely use this approach as more enterprise
software vendors develop AI capabilities. Stand-alone AI software vendors will therefore be under increasing pressure to provide at least an interface to existing enterprise software.

Democratization of Machine Learning Through Automation—The scarcity of trained personnel, including data scientists and AI engineers, has always been a substantial constraint on the use of AI. Now, however, several vendors offer automated machine learning, which makes it possible for less skilled analysts—sometimes called citizen data scientists—to do more sophisticated work. Automation software is increasingly able to perform key tasks required for machine learning. These include some aspects of data preparation, feature engineering or variable transformation, exploring different algorithms, selecting the best model, writing program code or APIs for models, and explaining what factors are particularly important to a model. These systems not only allow less skilled users to direct machine learning, they can also make machine learning which is guided by sophisticated data scientists more productive.

This AutoML software, as it is often known, is available both from specialized startups like DataRobot and H20.ai, and from more established cloud providers like Google and Microsoft. Some versions of AutoML focus on traditional statistical machine learning while others emphasize deep learning. Some are specifically aimed at citizen data scientists, and others at highly skilled professionals. Regardless of these variations in technology, AutoML is likely to hugely expand the use of machine learning by organizations and take the creation of statistical models into a post-algorithmic age. It may also free data scientists and quantitative analysts to devote themselves to managing change and designing processes for AI models.

Creation of AI Centers of Excellence and Other Management Structures—Many executives are establishing dedicated organizational units to weave AI firmly into their businesses. As with other new technologies (e-commerce, analytics, and even blockchain), establishing a principal support group or center of excellence (CoE) provides workers with coordination and leadership. Companies are devoting considerable financial resources to AI, and the necessary skills and experience are too rare to leave scattered around the organization with little coordination or collaboration.

In the 2018 Deloitte survey of large firms using AI, 37 percent said they had already established such a unit. Deutsche Bank, JPMorgan Chase, Nielsen, Pfizer, Procter & Gamble, Anthem, and Farmers Insurance are among the non-tech firms that have centralized AI oversight groups. They create a vision and strategy for AI in the company, establish a prioritized list of uses, delineate the data resources needed, and manage relationships with external partners. In some cases, CoEs help to develop AI applications for specific units and functions. They also may assist with management structures and processes related to AI. The 2018 Deloitte survey also found that:

- 54 percent have created a process for moving AI prototypes into production;
- 52 percent have created a road map for using AI;
- 45 percent have appointed senior executives as AI champions; and
- 37 percent have put a comprehensive strategy for AI into effect.

There is no perfect home for an AI center of excellence, but the most common approach is to house it within a broader data and analytics department. The role of chief data and analytics officer, which then becomes responsible for AI, is well established in a plethora of companies including General Motors, JPMorgan Chase, Travelers, Wells Fargo, MetLife, Partners Healthcare, Marsh & McLennan, Walmart, CVS Health, and many more. That office reports to a variety of executives, from chief of operations to marketing and financial officers, and even to the CEO, but not, generally, to the chief information officer.

Sparser Data AI Models—One of the key requirements for many AI systems, particularly deep learning models, is voluminous data. These data, their outcomes labeled, are used in supervised learning to train models. Less commonly, unlabeled data are used to discover patterns using unsupervised learning methods. But many companies can’t assemble enough data, and labeling it is almost always labor-intensive. AI vendors are therefore working on a variety of technologies that make it possible to build high quality models and systems with smaller amounts of real world data.

Some of these systems, such as generative adversarial networks, create their own synthetic data. Other projects strive to give machines common sense. It’s not clear which of these approaches will prevail, since they are currently the purview of research labs rather than commercial enterprises, but it seems likely that the data constraint on AI development and use will be eased before long.

Whither AI in the Enterprise?

Artificial intelligence has waned and waxed in the past. It has lagged during times of disenchantment, only to burst forth in growth and hype. Now it seems unlikely that there are any more cold, fallow winters in its future. There are thousands of AI startups, many organizations which believe strongly and invest in AI, and enormous technological progress along multiple fronts. AI groups are increasingly well established in universities, research institutions, and companies. Even some governments, including those of China, Canada, the United Kingdom, and Singapore, have launched programs for developing AI and accelerating its use in industry.
However, we should not underestimate the time it will take for AI to become ubiquitous in business and society. Unlike microprocessors, AI is not an exponential technology, doubling in capacity every year or two over a sustained period of time. It is improving only at a linear rate. Even if AI technology improves quickly in some cases, regulation or organization must still be changed before it becomes truly useful. Autonomous vehicles driven by AI are a prime example. Many such vehicles are already being tested on public roads and some experts suggest that 90 percent of the requisite technologies have already been developed. However, these experts also argue that the last 10 percent will require just as much effort and time as what has already been done.

AI will no doubt become a revolutionary force in the fullness of time, but right now it is largely evolutionary.

The greatest mistake that enterprisers can make with AI is to expect too much too soon. It will no doubt become a revolutionary force in the fullness of time, but right now it is largely evolutionary. As Amara’s Law suggests, we are likely to overestimate AI in the short run and underestimate it in the long run.

Thomas H. Davenport is the President’s Distinguished Professor of Information Technology and Management at Babson College, a Fellow at the MIT Initiative on the Digital Economy, and Senior Advisor to Deloitte Analytics. His most recent book is The AI Advantage: How to Put the Artificial Intelligence Revolution to Work.

End Notes

5. Eric Siegel, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die (Wiley, 2013).
8. A brief history of Neural Networks from the 1940’s through the 1980’s can be found at this Stanford Computer Science website: https://cs.stanford.edu/people/eroberts/courses/ssoc/projects/neural-networks/History/history.html A more complete history, from the 1940’s all the way to 2012 when multi-level neural networks, graphic processing units, and large training data sets were combined to win the Stanford ImageNet competition, is given at this Carnegie Mellon School of Computing web site: http://www.cscs.cmu.edu/~10700/slides/Perceptron_Reading_Material.pdf
9. See Tomerco J. Sajnowski, The Deep Learning Revolution, MIT Press, 2018, for an overview of the evolution of deep learning, with an emphasis on how perspectives and insights from neuroscience and from computer science have developed in parallel in recent decades and have influenced one another. The book also explains some of the important differences between the function of the human brain and that of multi-layer neural networks.
The New AAA Supply Chain

Agility, adaptability, and alignment (AAA) have long been key factors in the success of world-class supply chains. In recent years, changes in environments and natural forces pose new challenges. For those who wish to remain competitive, Hau Lee suggests that it is time to revisit these AAA capabilities to understand what they mean today.

Hau L. Lee
Graduate School of Business, Stanford University
In 2004, the Harvard Business Review published my article “The Triple-A Supply Chain.” In it, I described the vital elements of first-class supply chains – agility, adaptability, and alignment, constituting the Triple A. Agility describes the responsiveness, flexibility, and efficiency of a supply chain in meeting the day-to-day uncertainties and variations in supply and demand. Adaptability describes the strategies needed to make a supply chain dynamic, able to meet changes in needs and environment over time. Alignment ensures that the many and often diverse interests and incentives of partners in the chain be integrated to insure mutual benefits and success. Leading companies have long striven for these AAA capabilities.

Today, the nature of agility, adaptability and alignment have changed. To gain a competitive advantage from the new AAA supply chain, executives need a new focus.

Fifteen years after the debut of that article, I believe the AAA concept is still applicable, and that winning supply chains should still be agile, adaptable, and aligned. In order to master AAA, companies must have organizational leadership, vision, and commitment. Today, the nature of agility, adaptability and alignment have changed. To gain a competitive advantage from the new AAA supply chain, executives need a new focus.

Super-Agility

Agile supply chains are the province of companies with the ability to sense and respond to their environment. They detect demand and supply changes quickly, interpret the signals to avoid nervous responses, and even predict future events with considerable precision. Next they respond by preparing appropriate resources and sound plans in anticipation of random events, analyzing the best course of action when they occur, and acting promptly. “Quick response” or “fast fashion” companies such as Zara and 7-Eleven Japan have used these methods to propel their huge success in their respective industry sectors.

In a world in which information can travel in nanoseconds, agility has accelerated dramatically. I label this new element “super-agility.” Today’s digital technologies, coupled with social media, allow consumers to receive information, share ideas and preferences, and make purchase decisions in seconds. And they want correspondingly fast and reliable delivery. Measuring delivery time in days used to be viewed as agile. Now we talk about hours. These surges of demand in a very short window require companies to sense and respond at similar speed, to have a “super-sensitive sense” and a “super-responsive respond.” This super-agility is not just for retailers or e-tailers facing consumers directly. Suppliers at the other end of the chain face the same pressure. Truly super-agile supply chains must be super-agile from end to end.

Digital technologies such as the Internet of Things (IoT), big data, and artificial intelligence (AI) enable fast and smart sensing of both demand and supply conditions in real time.

So how can we achieve super-agility from end to end? We have to start by placing fast and smart sensing of demand uncertainties at one end, and a quick and flexible design at the other. Digital technologies such as the Internet of Things (IoT), big data, and artificial intelligence (AI) enable fast and smart sensing of both demand and supply conditions in real time. Digital sampling, virtual reality, and 3D-printing let us generate products super-efficiently. 3D-printing also allows products to be more efficiently personalized, customized, or built to order. Li and Fung, an apparel supply chain and trading company, has used digital technologies to cut its product sampling time from the industry average of thirteen weeks down to four, a 70 percent reduction. Instead of providing customers with an iterative sequence of physical samples, the company’s 3D-sampling technologies can much more quickly produce almost realistic digital samples, and modify them digitally as well.

But digital technologies are not the only solution. Companies must also skillfully deploy fundamental supply chain best practices. I was struck by the description of Hans van Alebeek, former SVP of supply chain at Nike, of how the company arranged to have the right jerseys on sale the day after the Super Bowl or the World Cup. They had to be the jerseys of the winning team, with some mention of their victory or, for a specific athlete, the MVP logo. Nike achieved this super-agility through careful planning. It stocked the right materials at different stages – fabrics, plain jerseys, jerseys with team logos, and even some customized prints in keeping with the predicted outcome. This kind of super-agility could also be achieved by producing championship products for both teams, but that would result in a huge inventory of the wrong products which would then have to be discarded or dumped into underdeveloped markets. Instead, Nike carefully assessed the risks of products at each stage of production,
stocking each appropriately. It was a beautiful example of smart inventory stocking and postponement.

Construction industry disrupter Katerra is using supply chain innovations to drastically reduce the duration of construction projects. The company’s model is rooted in a range of practices including extensive use of standardization, modularity, and postponement in housing design, moving the push-pull boundary through off-site prefabrication, appropriate vertical integration, sound procurement strategies, and tracking in detail both the progress of projects and the use of materials through cloud-based IoT. Katerra still faces many challenges in its bold venture and it is not yet clear if it will succeed. Regardless, with veteran supply chain executive and former CEO of Flextronics Michael Marks at the helm, the ambitious startup has certainly made excellent use of innovative supply chain concepts.

Super-agility is becoming critical for many online retailers. China’s e-tailers, like Alibaba and JD.com, met dramatic surges in demand on Singles Day, a shopping holiday in China. Amazon has likewise faced unprecedented demands during the COVID-19 pandemic, with so many people homebound. These companies weathered the storm by properly positioning their inventory ahead of time, deploying digital technologies, and cultivating an agile organizational culture.

**Architectural Adaptability**

In my original *HBR* article, I emphasized that companies needed to dynamically adjust their supply chain strategies to meet changing needs and environments. These changes are often in response to the maturity of the product or the market. For example, when a product is introduced, its supply and demand characteristics can be very different from when it is mature or approaching the end of its life. Some of a product’s supply sources may be in developing economies which, as they mature, become emerging or even developed economies. China is an excellent example. It is vital that supply chain executives be aware of such evolutions and be prepared to revisit their sourcing strategies in response to changes in labor costs, worker skills and education, local environmental and social regulations, logistics infrastructure, and the availability of resources.

When new trade restrictions go into effect, companies that can quickly adapt to new sources will come out ahead.

Adaptation of this kind must respond to many more dimensions in today’s business climate. Sourcing decisions have recently been complicated by the shifting trade and tariff policies of various regimes. Trade has retreated from multilateral agreements, becoming more and more bilateral. Regional trade agreements have proliferated while the rules for what constitutes country of origin have become more complex. Meanwhile, the rise of protectionism and national security concerns has contributed both to an increase in trade barriers and to the complication of customs calculations. At the same time, tariffs and trade agreements are dynamic, and may change erratically over time. The result is that supply chains must be adapted to frequent change. When new trade restrictions go into effect, companies that can quickly adapt to new sources will come out ahead.

Another critical dimension of adaptation is the integration of supply, innovation, and demand. While their sourcing strategies must reflect the changing landscape of supply, supply chain executives also need to design strategies that cover the entire supply chain. As emerging economies which once were simply sources mature and become capable of product and process innovations, they also produce a rising middle class, and with it important markets. Supply chain strategies should therefore reflect the changing characteristics of new economies not just as supply sources, but as innovation centers and demand points. Leading supply chain companies should be thinking about concepts such as “frugal innovation,” which devises products and processes to serve developing economies, crowdsourcing, as a means of generating innovative ideas for different markets, and “last mile” logistics, to serve customers in challenging locations.

The advance of technology also drives adaptation. Supply chain strategies should be poised to adapt as technologies become available, or as they are widely adopted by suppliers or customers.

The expanding needs and multiple dimensions of adaptation have led to a new role: supply chain architect. I learned the term from Dr. Victor Fung, chairman emeritus of Li and Fung. Dr. Fung’s view is that we should not adapt just to the differences of the time, but also to the many products, markets, or customer segments a given company may have. We need to design the right supply chain strategies, building an architecture that takes into account where production is sourced and supplied, whether to outsource, what technologies to use, and how to configure products to accommodate these differences. Of course, with the rapid advances of online business, even the strategic architects at Li and Fung have had to hurry to create the right adaptations.

This year we saw adaptation make a big contribution to the
battle against the coronavirus pandemic. Many companies were able to turn on a dime, retooling their production process, leveraging their technical know-how, retraining their workers, and, in some cases, using extra capacity to produce medical supplies like masks, protective gear, and ventilators. This rapid adaptation required the companies to be decisive, to have the right degree of flexibility, to use what they know and have, and to make the necessary investment. It is a very admirable adaptation.

Ecosystem Alignment
Alignment has traditionally focused on how to strengthen the partnership between buyer and seller. We align the interests and incentives of a buyer and a seller, so that each will act in such a way that both win. Buyer and seller must thus exchange appropriate information, define responsibilities and accountability clearly, and share the costs, risks, rewards, and consequences of their collaboration.

Now, various forces in our modern economies call for us to expand our view of what alignment entails. First, the supply chains of different industries have become more interdependent. Cosmetic companies such as L’Oreal have begun making electronic wearables, such that the cosmetics and electronic supply chains intersect. Entertainment supply chains have become more and more digital. Apparel manufacturer Esquel has teamed up with the New Zealand Merino Company to create Comerino, blending the cotton and wool supply chains to create a new cotton-wool product. So the consequences of an action in one sector can now affect not only immediate trading partners, but also other sectors.

Even nonprofit and for-profit supply chains can now intersect. COMACO, based in Zambia, was founded as an NGO to monitor and police activities that cause environmental degradation, such as animal poaching and deforestation. Discovering that the low incomes of farmers were the root cause of these activities, the organization expanded to offer training in sustainable farming, provide equipment and other resources for farmers, and help them to reach premium markets. The agricultural business is for profit, but it contributes to nonprofit environmental improvement.

The stakeholders of a given alignment are no longer just the buyer and seller. They may include local governments, NGOs, or communities, all with a stake in environmental and social issues.

The increasing concern and interest in environmental and social responsibility has two immediate implications for alignment. First, alignment is now concerned with more than just cost and revenue. Second, the stakeholders of a given alignment are no longer just the buyer and seller. They may include local governments, NGOs, or communities, all with a stake in environmental and social issues.

The importance of these concerns is also heightened by increased consumer awareness, and by the aforementioned adaptations in supply chains. As trade frictions increase and traditional supply sources mature, driving up costs, sourcing managers have expanded their range to include even frontier economies like Bangladesh and Ethiopia. Ensuring environmental and social responsibility is as critical to these expansions as aligning the interests of new stakeholders.

This expanded understanding of the value chain, to include multiple supply chains and a broader stakeholder base, has led supply chain companies to take an ecosystem view of supply chain alignment. Nestle’s Shared Value Vision and Nike’s Equitable Manufacturing Initiative are both about ensuring that each of a much bigger set of players in the supply chain wins. The welfare and livelihood of all of these stakeholders are now an integral part of alignment.

As the scope of supply chains expands in multiple dimensions, the use of digital platforms will become more and more important. Platforms bring together more constituents in the ecosystem to share information, coordinate, and exchange ideas, playing an ever-greater role in alignment.

Hau Lee is the Thoma Professor of Operations, Information, and Technology at the Graduate School of Business at Stanford University. His research into global supply chain management has appeared in major publications and won awards. He has also consulted extensively for industry. He is a member of the US National Academy of Engineering as well as a Fellow of INFORMS, POMS and MSOM.
Digital Operations:
Autonomous Automation and the Smart Execution of Work

Robert N. Boute
KU Leuven and Vlerick Business School

Jan A. Van Mieghem
Kellogg School of Management, Northwestern University

By digitizing operations, companies may replace manual work with increased automation, but they may also augment human work through smarter execution. Robert Boute and Jan Van Mieghem present a conceptual framework that distinguishes the different levels of digitization, automation, and intelligence. This framework can serve as an audit, helping companies to assess where they are now and where they could be in the future.
The integration of digital technologies into the running, managing, and planning of organizations is growing steadily.

The integration of digital technologies into the running, managing, and planning of organizations is growing steadily. We have developed a framework to structure our understanding of what digitization means for the operations of individual companies. Operations refers to the repetitive activities that comprise an organization’s process. Our framework separates two important dimensions of digital technologies: those that facilitate automation or the autonomous execution of work, and those that use smart control algorithms to make how the work is executed more intelligent. Managers we have worked with found the framework useful as a diagnostic tool that reveals how an organization’s work is currently being executed and how digitization may change that in the future.

Digital Operations: What’s in a Name?
Digital operations means that a company’s workflow (that is, its sequence of activities) is digitally supported, if not fully digital. Digital operations must therefore start with digitizing the process flow, including all work instructions. The Belgian company Proceedix, for example, moves clients’ workflows from paper to digital form. To perform a task, operators then follow the work instructions on their laptops or mobile devices. Good work instructions reduce mistakes and ensure uniformity of execution, which increases the company’s quality and efficiency. These digital work instructions are also easily customized and allow the organization to manage complexity more effectively and provide greater variety.

A company’s workflow can be digitized as a siloed application on an individual electronic device, which we refer to as digital level 1. A spreadsheet, for instance, digitally supports the workflow, yet may not be integrated or otherwise communicate with other applications or information. Higher levels of connectivity lead to higher levels of digitization. Level 2 describes moving the workflow and the data to an enterprise platform which can collect, synchronize, and integrate data across the company’s various activities. 7-Eleven Japan, for example, set up its own connected enterprise data platform before the Internet protocol was widely adopted in industry.

At level 3, the platform is accessible over the Internet and standard Internet protocols introduce new possibilities including web-based applications, remote assistance, and connectivity with third-party apps. By giving operators web-based access to a central platform, Proceedix enables remote assistance and communication of digital work instructions. At level 4, the platform becomes more scalable because it is hosted in the cloud, for example through Amazon Web Services (AWS), Google Cloud Platform, or Microsoft Azure.

Finally, at digital level 5, also referred to as a digital control tower, companies can view real-time data from physical devices connected to the Internet—the Internet-of-Things (IoT)—and from the mobile and wearable communication devices that
allow the so-called Internet-of-People (IoP) to function. The European rail-freight and logistics company Lineas monitors its locomotives in real time. Its sensors not only track the location of assets, but also monitor their condition. Lineas combines all this information into a digital twin of its physical operation which allows the company to conduct predictive diagnostics and maintenance. These cyber-physical systems (CPS) are key elements of Industry 4.0, a term which originated in Germany to describe the fourth industrial revolution. The distinguishing feature of CPS is extensive real-time connectivity through IoT and IoP. The latter is vital in allowing digital systems to capture human intervention, an information flow which is seldom recorded in any detail in paper or even PDF instructions. When digital workflow instructions include “inspect” followed by “report,” for example, inspectors or repair operators can immediately upload their inspection findings and interventions from the field (by text, voice, or image) using their mobile devices. This manual IoP data augments the IoT data automatically captured by sensors and can also serve as feedback data for further improvement. IoP also allows the system to generate personalized digital work instructions (e.g., adjusted for the operator’s experience) which can accelerate high-quality onboarding, training, and task execution.

While higher levels of digitization open up new opportunities, it is important to keep in mind the downside of using an Internet-enabled platform: cyber risk and ransomware. In January 2020, Picanol Group, a producer of weaving machines, had to close plants in Belgium, China, and Romania for more than a week after a cyber attack. Cyber risk has risen to become the most important danger to global business in the 2020 Allianz Risk Barometer and managers are becoming ever more aware of it.

Digital workflows, and digital operations in general, present a progression of new opportunities from real-time monitoring and visualization to analysis and optimization using advanced algorithms, and perhaps artificial intelligence. The dizzying array of possibilities leaves organizations wondering how to participate in this digital transformation. It also drives a societal debate on the impact of artificial intelligence on human work. In both of these cases, we believe it is useful to disentangle the effects of automation and autonomy from those of smart control and artificial intelligence.

Digital operations facilitate the automation of work, allowing the work to be performed by a machine instead of a human. That machine may be a programmable mechanical device such as a robot, or a software application that performs automated tasks, known simply as a bot.

**Automated and Autonomous Operations**

Digital operations facilitate the automation of work, allowing the work to be performed by a machine instead of a human. That machine may be a programmable mechanical device such as a robot, or a software application that performs automated tasks, known simply as a bot. For example, as ever more financial transactions are tracked and integrated digitally, Spanish tax authorities have gained sufficient data to allow a bot to automatically fill out tax forms. In a product supply chain, automated digital operations might include automatic periodic preventive maintenance or replenishment. Amazon Prime customers can thus sign up for automatic monthly delivery of consumables like toilet paper. Computer numerically controlled (CNC) machines, such as 3D printers for additive manufacturing and digitally controlled flexible manufacturing systems (FMS), are also examples of digital automation.

Digital operations do not necessarily mean that the work is automated. Similarly, automation does not necessarily involve digital autonomy.

Nonetheless, digital operations do not necessarily mean that the work is automated. We can file our taxes digitally by downloading the necessary tax forms, filling them out manually on a computer or smartphone, and submitting them electronically.

Similarly, automation does not necessarily involve digital autonomy. The automation of the first industrial revolution clearly preced ed the computer age. Its machines could not sense their environment or run autonomously, so they required human supervision. Autonomy means acting alone, following your own laws or control and not being under the rule of another.

Automation and autonomy came together a century ago when Sakichi
Toyoda invented a powered textile loom with an automatic stopping device. A mechanical sensor automatically and immediately stopped the loom when the thread broke or ran out. This innovation reduced the production of defective products and greatly improved labor productivity. Because the machines no longer required continuous supervision, one human could supervise many machines. This concept of autonomous or intelligent automation was named jidoka or “autonomation” and became a cornerstone of the Toyota Production System. Autonomous automation describes machines that are capable of operating without direct human control or intervention.

The distinction between automation and autonomy highlights the role and location of control rules. Every task in an operation requires a control rule (or algorithm) dictating when and how the task should be performed. Inspired by the taxonomy of the Society of Automotive Engineers, we distinguish four levels of automation and autonomy. Automation with human supervision, level 1, separates the human control from the machine. For example, a credit card application process includes various customer credit checks. The computer prompts a checklist and the bank manager makes a decision about each check.

Level 2 embeds the control within the machine, giving the machine autonomy in certain conditions but requiring human intervention in others. Toyoda’s loom, for example, ran autonomously as long as the thread did not break or run out. Likewise, credit card applications are automatically approved as long as the customer’s credit score, employment history, and income level are sufficiently high and outstanding debt, number of credit cards, and requested credit card limit are sufficiently low. If these conditions are not met, the system requests human intervention in the approval decision.

Level 3 is automation which is fully autonomous in a given environment. The credit card approval process is totally automatic only in certain cities, counties, or states where all credit card application information is available and trustworthy.

Level 4 describes automation which is entirely autonomous in all environments. This would include autonomous vehicles without steering wheels and other automation that cannot be overridden by human intervention. The precise distinctions between these levels are debatable since it depends on how frequently, easily, and quickly humans can and do override the automation.

**Smart Operations**

Digital operations can improve the intelligence of the control rule. It can make control rules adaptive, contingent, dynamic, and personalized, creating control rules that can sense and learn by using state variables and observations. We refer to control rules or algorithms that embed intelligence as *smart*.

<table>
<thead>
<tr>
<th>Smart Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. No feedback-control</td>
</tr>
<tr>
<td>1. Explicit instructions contingent on one feature</td>
</tr>
<tr>
<td>2. Explicit instructions contingent on multiple features</td>
</tr>
<tr>
<td>3. Machine learning</td>
</tr>
</tbody>
</table>

**Prediction** \( Y = f(X) + \epsilon \)

- \( Y \) given features \( X \), predict \( Y \) using a mapping function \( f \)
- Prediction error \( = \epsilon \)
- Supervised \( = f \) was trained on labeled historical data
- Deep learning \( = f \) is a deep neural net

Condition-based preventive maintenance is smart because it schedules inspection or repair based on the actual condition of the machine. Preventive maintenance on a set schedule, by contrast, is not smart because it does not use any adaptive feedback control.

We distinguish three levels of smart control. Smart level 1 or 2 describes a control rule or algorithm which consists of a sequence of explicit instructions that are contingent on, respectively, one or multiple input variable(s) or *features*. In inventory management, a system which decides the replenishment quantity and time only on the basis of bringing current inventory up to a set target point is smart level 1. A decision tree that consists of multiple if-then instructions with regard to multiple features—e.g., the *expert systems* of the 1980s—is smart level 2. Similarly, the automated guided vehicles which have operated along premarked routes in warehouses for decades are also level 2. They are controlled by exhaustive explicit if-then instructions, and so can only function in highly restricted environments. In May 2019, a 12m-long uncrewed boat crossed the North Sea autonomously. It relied on multiple sensors (sonar, radar, lidar, camera, infrared, GPS, etc.) to safely navigate one of the busiest shipping lanes in the world.

When the number of combinations in the input variables of the control algorithm explodes, enumerating explicit instructions becomes infeasible. Smart level 3, then, refers to machine learning algorithms which effectively perform a specific task without using explicit instructions, relying instead upon patterns and inference.

In order to drive autonomously in unrestricted environments, the system relies on machine learning algorithms, called *prediction machines*,\(^2\) that predict what a human driver would do given specific road
conditions. The prediction machine bases its decisions on labeled training data consisting of many observations of human behavior (actions) at specific values (states) of environmental variables (features). For highly complex prediction problems, machine learning can utilize a neural network with multiple layers between input and output, which mirrors the human brain. This process is known as deep learning and is the basis of many image recognition systems.

In addition to predicting events, such as machine breakdowns or transport delays, machine learning algorithms can also prescribe (near-optimal) actions. The ancient game of Go is played on a board with 19 x 19 = 361 positions (features) each of which can contain a black, white or no stone. It therefore has $3^{361} \approx 10^{172}$ possible states, more than the number of atoms in the universe. Devising explicit instructions (prescriptions) for how to play each state is therefore impossible. (In mathematical terms, the optimal value function of the Markov decision problem cannot be solved for precisely.) One branch of machine learning thus uses and refines an approximate (value) function from which the system can derive a recommended action for any state. This mathematical approach yields a machine learning algorithm that makes its own decisions and hence is described as artificial intelligence. The first machine learning algorithm to beat 9-dan ranked professional Go player Lee Sedol in March 2016 was AlphaGo. It used a thirteen layer neural network to select moves. The same deep learning algorithms can be used to make replenishment decisions in a complex environment with many suppliers or channels, or to make optimal transport decisions based on current traffic information.

Adopting machine learning typically requires (1) a large training data set through which the system can estimate, fit, or tune the algorithm and (2) data for the actual prediction. Electric car manufacturer Tesla also uses (3) feedback from drivers to improve the prediction accuracy. Companies often invest extensively in IoT in order to use the resulting data for predictive analysis. But IoT by itself does not capture how humans respond to a request or alarm from a smart system. The use of digital workflows allows the system to capture these human interventions which comprise the aforementioned IoP. It thus extracts data on which interventions were made, by which operator, to address which request, or was this a false alarm. This feedback data can be used to improve the algorithms. Digitizing operations is therefore a prerequisite of smarter operations and the implementation of machine learning.

**DAS Framework for Digital Operations**

The DAS framework synthesizes three perspectives on operations: digital, automated, and smart.

**Diagnostic**

The DAS framework can serve as a diagnostic, allowing organizations to assess the current state of their digital operations. This assessment can focus on any number of specific processes, or even the entire value chain, evaluating each task along the three dimensions and assessing them according to the rubric in Exhibit 1. A company could thus focus on assessing the digitization of customer interaction, collecting customer input data to personalize successive steps in the process. By bringing the customer interaction inside the value chain and explicitly capturing how goods and services are marketed to customers, the company can personalize its product offerings and price in real time. For example, while selling and approving home and renter’s insurance, the Lemonade Insurance Company digitizes and personalizes its customer interactions. The firm can use the diagnostic to assess a
range of internal processes, as well as outbound logistics or customer service. The Lemonade Insurance Company also uses bots rather than insurance brokers to handle claims.

Note that not all $5 \times 4 \times 3 = 60$ combinations of digital, automated and smart levels are necessarily feasible. A siloed spreadsheet application, for instance, is unlikely to generate sufficient data for machine learning analysis.

A framework for future directions

For simple automation that does not require autonomy, the DAS framework can be summarized by the $2 \times 2$ matrix in Figure 1. The four quadrants provide a visualization and vocabulary through which companies can discuss where their digital strategies can, and more importantly should, take them next. Exhibit 2 adds non-digital strategies, defining seven zones according to the intersections of our three perspectives on operations while also providing concrete examples in the context of order replenishment.

Digital operations facilitate smarter control rules or algorithms by capturing and storing big data, that is, data sets with many observations (rows) or many features (columns), from digital transactions or physical sensors. In Figure 1, this ability is represented by moving from the pure digital quadrant to the digital+smart quadrant. For example, Pacif-i sells a pacifier which contains a Bluetooth temperature sensor so you can remotely monitor your baby’s temperature. This feature enables a concurrent statistical process control to send alerts. Tracking and storing time-stamped data allows the system to train its machine learning algorithms in order to improve pattern recognition and make alerts smarter (e.g., based on the speed of the baby’s temperature change). As the algorithm becomes smarter, its predictions become more accurate. Eventually, the system could automatically request medical intervention.

Digital operations may also facilitate simple robotic process automation (RPA). RPA can start by tracking human clicks while operators perform a tedious task on a computer and then train an algorithm to perform that same task faster, cheaper, and more accurately. The Romanian company UiPath has adopted an “automation first” approach to digital transformation. In Figure 1, this trajectory is represented by moving from the pure digital quadrant to the digital+automated quadrant. Relieving humans of tedious tasks frees up their creativity and time for higher-value tasks.

It is important to recognize that moving to different quadrants in the framework requires companies to invest in different human abilities.

It is important to recognize that moving to different quadrants in the framework requires companies to invest in different human abilities. Digitizing operations requires workers with knowledge of computer science, databases, software development, user interfaces, and information technology. Using smart algorithms requires workers who specialize in operations research and data science to run analytics, statistics, and optimization. Automation requires workers who understand mechanical and electrical engineering as well as computer science to build physical robotics and software bots.

Autonomy and Human-Machine Collaboration

For simple automation that does not consider autonomy, the $2 \times 2$ matrix in Figure 1 may be a sufficient diagnostic. For example, whether you set your coffee-maker on automatic mode is a simple 0 – 1 decision. In manual mode, you turn the coffee maker on at 6am; in automatic mode, you set a timer in advance that will automatically turn the machine on at the designated time. Because both the environment
and the automation are limited, there is no need to capture the autonomy’s degrees of freedom.

For more complex automation with autonomy, we need more nuance and depth in the matrix. We gain more insight by adding the more specific levels of automation, autonomy, and smart control, as in Figure 2. For a car to drive autonomously, we must ask what control inputs it requires and how the environment will evolve so that optimal control becomes a dynamic, adaptive function of the state space. Companies should only proceed to higher levels of autonomy once the control rule can predict with sufficient accuracy.

Smart algorithms can provide decision support to human workers. This kind of improvement of the symbiosis between human and machine through smarter control rules constitutes a horizontal increase in Figure 2. As the smart control algorithms improve their accuracy, they may become more trustworthy so that their downside risk is contained. The company may then move toward automation with increasing autonomy. This process equates to vertical increase in Figure 2, from manual or human-supervised machines to autonomous ones. Companies may also choose to increase autonomy and smart control simultaneously (i.e., moving up the diagonal) but to do so, they must apply multiple human capabilities simultaneously.

It is vital that designers always retain human oversight and high redundancy in systems with large downside risk.

The key implication of this framework is that the upper left zone is undesirable, and sometimes even dangerous. On October 29, 2018
Exhibit 2: Adding non-digital strategies yields seven zones, illustrated for order replenishment

Allowing for non-digital strategies yields seven zones, derived from the intersections of the three perspectives—digital, automated, and smart—on operations (Fig. 3). Like the quadrants, the seven zones, together with the earlier defined levels, provide a visual and a vocabulary with which to discuss the future of the organization’s digital journey (“where can we go?” or more strategically, “where should we go?”). As a specific example of the seven zones, consider the order replenishment process. First we define the three circles, and then the seven zones created by their intersections.

Circle Digital = human operator digitally orders from the supplier using a siloed application (e.g., spreadsheet, email) on their personal device (digital level 1). Digital levels 2, 3 and 4 refer to the data and the order being integrated into an enterprise platform. Digital level 5 refers to the operator being able to see the supply chain in real time through digitally-captured data (control tower).

Circle Smart = the ordering decision uses an explicit inventory control rule, which can depend on only the inventory status (smart level 1) or on multiple inputs such as inventory on hand, age of the inventory, inventory in transit, and demand forecasts (level 2). Smart level 3 means that the inventory control rule is derived using machine learning.

Circle Automated = the ordering decision is suggested automatically by a bot and is approved by an operator (level 1). Conditional on the values of the item’s features (e.g., its type, unit cost, demand rate, forecast accuracy), the order is placed automatically and autonomously (level 2). Level 3 refers to automatic, autonomous order placement for any item in pre-defined product families; and level 4 for all products.

The seven zones now follow from set algebra:

1. D = digital order replenishment process executed by a human operator based on personal experience; i.e., without using an explicit, or machine learning generated, control rule.
2. S = conventional, non-computerized order replenishment process executed by an expert human operator utilizing an explicit control rule relying on data that is non-digitally captured. (Note, by definition, smart level 3 is impossible in a non-digital setting.)
3. A = automated ordering that is neither computerized nor smart; e.g., daily (time-based) milk delivery.
4. DA = time-based automatic digital ordering (e.g., Amazon Prime weekly delivery)
5. DS = digital order replenishment process executed by a human operator utilizing an explicit control rule relying on data that may be digital. (Machine learning is now possible through digital data.)
6. AS = automated ordering that is not computerized but utilizes a smart control rule; e.g., consumption-based automatic ordering perhaps using an analogue sensor of inventory status.
7. DAS = digital, automated, smart order replenishment.

Human oversight is also important wherever people prefer or expect human involvement. KLM Royal Dutch Airlines became a front-runner in digital operations by emphasizing smart control over automation. The company touts its use of “data and advanced analytics to coordinate decision making involving fleet and ground operations, maintenance, crew, and passenger needs, for every flight every day.” It has learned that “optimizing operational performance can never be fully automated. Although companies need the right systems in place, even a theoretical best-in-class carrier—armed with state-of-the-art processes, data, and technology—requires employees to apply good judgment and make smart decisions.”

and March 10, 2019 respectively, it should have been much easier for the pilots of Lion Air’s flight 610 and Ethiopian Airlines flight 302 to override the Boeing 737 MAX’s MCAS flight controls, a system which tragically depended on only one sensor (the angle of attack). It is vital that designers always retain human oversight and high redundancy in systems with large downside risk.
The Business Case for Digital Operations

Of course, each company’s starting position and ideal direction of movement in the framework are unique and should be informed by a strategic assessment and a cost-benefit analysis.

Companies should weigh the incremental cost to increase the level of digitization, automation and autonomy, and smart control against the incremental need and benefit of the improved quality, accuracy, speed, personalization and choice, or reduced cost.

For example, non-invasive prenatal testing (NIPT) predicts the likelihood that a developing fetus will be born with certain genetic anomalies. In contrast to invasive procedures like amniocentesis, NIPT does not increase the risk of miscarriage. Moreover, NIPT uses digital DNA sequencing that generates lots of data which can then be used to train machine learning algorithms that, in turn, improve prediction accuracy and detect additional genetic anomalies. This last factor was the main motivation for the Center for Human Genetics at the University Hospitals Leuven, Belgium, to become a world-leader in NIPT as of 2013.

Because of the improved quality and the continual reduction in the cost of DNA sequencing, Belgian health insurance systems began covering NIPT on July 1, 2017. There was a three-fold increase in the demand for NIPT over the subsequent year, which the Center met by automating the analysis process, which consists of DNA extraction from plasma, preparation and sequencing, and bioinformatic analysis. As the volume of data generated increased, the system’s prediction accuracy improved. This reciprocity resulted in a virtuous cycle of growth in throughput, quality, and diversity of genetic anomalies screened while reducing the cost per NIPT test by more than 50 percent over five years.

Call to Action

Digitizing operations presents a plethora of opportunities. Exhibit 3 gives examples of how machine learning can improve work. We

Exhibit 3: Machine Learning Tasks & Digital Ops Examples
caution, however, that the fundamentals of good operations management remain. First, before digitizing or automating, streamline, standardize, and optimize your workflows, or you may end up automating waste.

Second, focus on data quality and quantity. Develop a data strategy that will allow you to collect and capture, organize, store, and maintain data. Reliable data is a prerequisite for effective smart control rules. We have found that collecting trustworthy quality data can be very challenging. Once your internal quality data is properly organized, you may wish to consider a federated database system to share data while protecting confidentiality.

Third, prepare your organization for a data-driven culture which augments human work. Clearly, workers are more likely to accept and trust a system if it shows high prediction accuracy in its data-driven recommendations, let alone prescriptions. Nevertheless, even automation with human supervision or conditional autonomy (levels 1&2) can provide substantial benefits which will encourage worker buy-in and support.

Fourth, invest in new human capabilities: knowledge and skills. Recall that increasing automation requires different capabilities from increasing smart controls. A strategic move between quadrants in the framework should thus include investment in different knowledge and skills.

Conclusion
Digital operations create new strategic opportunities. By adopting smart control and artificial intelligence, companies can augment human work and improve the quality, speed, variety, and personalization of their products or services. Digital also facilitates automation, but before considering higher levels of autonomy, companies must establish smart control with high prediction accuracy. We recommend exercising serious caution before eliminating all human intervention, especially in situations with high downside risk.

Establishing digital operations, whether they be smarter or more automated, can lead to increased demand and even open up new business opportunities. This process may eliminate some jobs but may also create new ones. For example, by partially automating NPT procedure, the Center for Human Genetics has increased its clinical and non-clinical staff, bioinformaticians, and software engineers and continues to recruit intensely. We hope that our diagnostic tool can inspire debate on how digitization may be put to best use in the future.

In this article we have focused largely on routine operations with high frequency workflows that can readily be codified for smart control algorithms and automation. We recognize that there are larger strategic questions which we have not addressed, including how to support a leadership team as it digitizes higher level cognitive tasks and processes. The interactions between human judgment and automation are more complex in knowledge-intensive work, such as negotiation or strategy formulation workshops that are not easily reduced to a flow chart. Streamlining such complex processes calls for extensive and fascinating future research.

Endnotes
1. Digital means represented by numbers or, colloquially, computerized. The word digital is derived from the Latin word digitus meaning finger. Counting on your fingers led to a digit being one of the elements that collectively forms a system of enumeration. Operations derives from the Latin word opus meaning work.

Acknowledgments:
We thank the anonymous reviewers as well as Gad Allon, Achal Bassamboo, Stephen Disney, Joren Gijsbrechts, Sameer Hasij, Marc Lambrecht, Eric Legius, Leen Magchiels, Tava Olsen, Peter Verstraeten, and Dennis Zhang for insightful feedback.
Twenty years ago, it would have been considered heresy to doubt the usefulness of the capital asset pricing model (CAPM) in assessing the cost of capital. Ivo Welch argues that, today, the CAPM should not just be doubted—it should be discarded.
**The Cost of Capital and the CAPM Are Ubiquitous**

Few numbers in business are more important than the cost of capital (CC). It is not possible to make intelligent investment choices without a good estimate of the CC. It determines which projects should be taken on and which should not. If a project has a CC higher than its expected rate of return, then it costs more than it is worth. And the CC is pervasive. For example, the cost of steel may influence construction projects, but it won’t influence, say, a sales campaign. The CC, on the other hand, influences all projects.

The workhorse CC model for nearly half a century has been the Capital Asset Pricing Model, or CAPM. It dominates textbooks, teaching, and practice. Over 90 percent of all publicly-traded companies use it. Courts and appraisers also use it. In many contexts, it is even the only accredited model.

Unfortunately—and I write this with a heavy heart—the CAPM is not just imperfect; it is so badly wrong that it is best ignored.

Before I explain why, you are probably thinking: very well, but then why is this model (still) being taught and used so ubiquitously? The answer is disconcerting. It was we academics who committed the original sin. For a long time we were so enamored with the intrinsic beauty of our model that we simply ignored the evidence. It took a long time for us to come to grips with reality. In the meanwhile, the CAPM had taken on a life of its own. These days, the servant has become the master; the model has to be taught because others are using it and they expect everyone else to know and to use it. In a world of Ptolemaists, it is unimportant whether the sun actually revolves around the earth. What’s important is to know how Ptolemaists calculate epicycles.

The CAPM is the cozy bedtime story that tells students and practitioners that the world is in good order and that they have learned something which will allow them to understand it. But the real world isn’t like that.

**A Brief Primer on the CAPM**

For readers who have forgotten what the CAPM was all about, or haven’t gotten that far yet, let me first briefly explain it, and why it is so beautiful, simple, and useful. The CAPM is a model with only three inputs:

1. the (economy-wide) risk-free rate of interest;
2. the (economy-wide) expected risky rate of return (usually on the stock market);
3. and a “market-beta” (or just “beta,” for short) that measures diversifiability.

Beta risk is not the own volatility (standard deviation) risk of a project. Instead, it is a measure of how the rate of return on a project correlates with the overall rate of return of the stock market on average. A beta of 2 means that for every 1 percent increase or decrease in the stock market, the project tends to go up or down by 2 percent. A beta of –1 means that when the market goes up by 1 percent, the project tends to go down by 1 percent, and vice-versa. A beta of 1 means the project typically moves (noisily) in

![Figure A: The Security Market Line](image-url)
line with the stock market. And a beta of 0 means the project typically does not move together with the market. Figure A shows the security market line, which is the graphic analog of the CAPM.

In a heavily diversified market-like investment portfolio, a good way to think of the market-beta of a project is as a measure of its toxicity. Holding the expected rate of return equal, an investor would prefer a project if it rescues her in the next market crash, i.e., if it tends to go up when the rest of her portfolio goes down. In extremis, investors can even be happy with projects which have negative expected rates of return, just as long as their betas are negative enough.

If this seems absurd, think about insurance. Most of the time, the insured pay the premium but get nothing back. The expected rate of return on insurance is usually negative. But customers still want to purchase insurance, because the upside appears in the worst eventuality (e.g., when the house burns down). Likewise, a project with the right beta pays off in the worst stock market eventuality (e.g., the Covid 19 epidemic).

The CAPM says that after investors have done all that smart diversification that allows them to reduce their risk for free, what remains is a trade-off between beta risk and reward. If a project has too much reward for its beta risk, too many investors will rush in, drive the price up, and thereby drive the reward down. In the perfect world of the CAPM, such stampedes happen so instantly as to be barely perceptible.

And beyond its beautiful and intuitive logic and graphical representation, the CAPM comes with a beautiful and simple quantifying formula:

\[
\text{Expected Return of any Investment} = \text{Risk-Free Rate} + (\text{Expected Return on the Market} - \text{Risk-Free Rate}) \times \text{Investment’s Market Beta}
\]

The formula makes sense. All three inputs are of first-order importance even if the CAPM is not true: (1) The risk-free rate is about whether it is better to consume or better to save and invest. (2) The market premium (also called the equity premium) is about whether it is better to invest in risky projects or non-risky projects. Because risky stocks should earn more than risk-free bonds, it should be positive. (3) The market-beta is the best measure of the undiversifiable market risk of an investment project. It is important to any investor who holds mostly the market portfolio. This is true even if the CAPM is wrong.

Even better, by quantifying generic intuition, the CAPM formula gives managers a concrete capital-budgeting input to use in their spreadsheets. It is a common (but not necessarily correct) practice to use historical rates of return for the equity premium. Over the last fifty years, short-term government bills, long-term government bonds, and (long-term) U.S. stocks have produced a geometric average pre-tax rate of return of about 5 percent, 8 percent, and 10 percent per year, respectively. (Inflation ran just under 4 percent.) If history is a good guide, a good forward-looking market-premium estimate today would therefore be about 2-3 percent per year.\(^1\) With some finesse, it is easy to estimate a good predictive measure of market-beta. (Warning: Be aware that the beta measures posted on popular websites are generally not very good.\(^2\))

Of course, even if the CAPM were a good model, it would still require well-reasoned inputs and correct usage. Jacobs and Shivdasani’s 2012 article\(^3\) provides an excellent overview of common mistakes made in the application of the CAPM. Even in the most capable hands, the CAPM has only ever been considered applicable to large companies held by well-diversified investors. It has often been used incorrectly in situations in which the owners are not well diversified and the available capital markets are imperfect.

So What is Wrong?

All models are wrong—they are only models, after all. So why be so harsh to the CAPM? Because the CAPM is worse than just a little wrong. The data proves that the CAPM is worse than useless. The primary disagreement which remains among finance professors is whether it is merely worse than useless or statistically significantly worse than useless.

I could write a treatise on the theoretical and empirical nuances of the CAPM—befitting a PhD practitioner of the Aristotelean art of defending the CAPM—but the truth is much simpler and, once exhibited, difficult to forget.

Ultimately, the CAPM provides one basic prediction: high-beta stocks should outperform low-beta stocks on average, because high-beta stocks are riskier. Unfortunately, the data say the opposite. Even over long periods, average rates of return have been higher for stocks with low betas than stocks with high betas—the opposite of what the CAPM claims. The CAPM prescribes high expected returns for exactly those stocks and industries that have shown low average returns, and vice-versa.

Figure B shows this effect. It plots the historical rates of return for two portfolios, one with all publicly traded stocks in the lowest beta tercile, the other with all stocks in the highest beta tercile. (All portfolio assignments were determined at the start of each year.) The plot shows no evidence that high-beta stocks offered higher average rates of return. Simply put, the high-beta stocks were doubly bad deals for investors who mostly held the overall stock market. They had higher risk and lower average rates of

\(^{1}\) Inflation ran just under 4 percent.

\(^{2}\) Although not statistically significantly.

\(^{3}\) Jacobs and Shivdasani’s 2012 article provides an excellent overview of common mistakes made in the application of the CAPM.
return. In a CAPM world, this should not be the case.

Who would want to put their faith into a rocket that, historically, has exploded half the time?

Of course, this historical return pattern may just be bad sampling luck. If high-beta stocks truly had higher expected returns than low-beta stocks, and Figure B merely describes how it happened to turn out during a bad stretch, then maybe the CAPM was just unlucky. This could be true. But then who would want to put their faith into a rocket that, historically, has exploded half the time? Yes, the rocket may be well designed and the explosions merely a run of bad luck. But with this track record, would you want to climb aboard?

Recalling your business school days, with finance professors teaching arbitrage conditions left and right, most notably in options pricing, doesn’t the failure of the CAPM violate some sacred natural arbitrage condition? No. The CAPM relies on so many strong assumptions that are violated in practice, that in retrospect it would have been a miracle if it had held true.

Nevertheless, that stocks with higher market-betas had lower average rates of return is an uncomfortable truth even in a non-CAPM world. Stocks with low market-betas have always been less risky (to heavily diversified investors) than stocks with high market-betas. Why, then, have these low-beta stocks offered average rates of return that were just as good? We don’t really know. It seems perverse, but what diversified investor would not prefer low-beta stocks over high-beta stocks? The evidence does suggest some practical investment advice: as an investor, you should tilt your portfolio towards low-beta stocks. Such portfolios tend to suffer less overall risk for the same average rate of return than un-tilted market portfolios. Just remember, past performance is no guarantee of future performance. Still, and unsurprisingly, the low-beta portfolio strategy also performed very well in the COVID 19 market crash of March 2020.

**Practical Managerial Advice**

The failure of the CAPM may present investors with a good opportunity, but it creates a dilemma for corporate managers. How should they calculate the rate of return that diffuse public investors will demand from their projects? If they should not use the CAPM to estimate their hurdle rates, that is, their opportunity costs of capital for similar projects, what model should they use?

Finance researchers have some useful advice. Yet, unfortunately, even professors who dedicate their lives to exploring this subject do not understand the full picture. The real world of managers will never be as neat and nice as the CAPM was.

Assuming such perfectly equal CCs seems to be at least as good a method as using CCs suggested by the CAPM, even for large publicly-traded firms.

One running joke among finance professors is that the CC for equity is always the same (maybe 8-10 percent per year arithmetic, 6-8 percent per year geometric). These numbers are equivalent to using the CAPM with (badly estimated) identical market-betas on each and every project equal to 1.0. Given the evidence that high-beta stocks offer lower average rates of return than low-beta stocks, assuming such perfectly equal CCs seems to be at least as good a method as using CCs suggested by the CAPM, even for large publicly-traded firms.

None of this means that either beta or risk does not matter. Beta
still measures the diversification effectiveness of projects for most investors. Outcome probabilities still have an immediate correlation to expected cash flows. It also doesn’t mean that all projects should actually have the same CC. Furthermore, this equal CC prescription is only appropriate for the equity component and not the debt component. (For small non-diffusely held firms, the CAPM was never appropriate to begin with.) Moreover, there are other important considerations that have or should have played a role in good practice even if the CAPM had, by and large, held. Again, Jacobs and Shivdasani cover a good number of potential CAPM misapplications, many of which still exist in this brave, and without a CAPM, messier, new world.

**Ten Capital-Budgeting and Cost-of-Capital Suggestions**

So how can we do better? Unfortunately, in the absence of a rigorous universal model to replace the CAPM, there are no hard rules or formulas. We can only fall back on situational prescriptions widely believed to be solid (at least among finance professors). These require more judgment than the CAPM did, with best practice changing from project to project. In many cases, they require customer-specific estimates and assessments. Of course, project specific estimates have always been important to the net present value (NPV) numerator for expected cash flow estimates. Now they are also important in the NPV denominator, the CC estimates.

**Project-Specific**

My first two recommendations pertain generically to specific project valuation:

1. **Comparables: Avoid NPV/IRR (internal rate of return) capital budgeting decisions if you can.** If there is a competitive and liquid market for similar projects, chances are that there are good comps, that is comparables, in the market. Rely on them! Good comps tend to be better than NPV analyses. Not only does NPV analysis require estimating the CC, it also requires estimating expected cash flows. If dozens of similar goods have recently been sold, why not instead learn from the value assessments of their buyers and sellers?

For example, if buildings have sold at twenty times the rental rate, chances are that a similar building is a bargain if the seller asks for fifteen times the rental rate and a dud if the seller asks for twenty-five times. Although an NPV and sensitivity analysis can still help you to better understand the economics of buildings, chances are that ad hoc situation-adjusted comps will be more accurate in pricing buildings than even the best NPV analyses.

2. **Cost-of-Capital Weighting: The overall CC remains a weighted average of debt and equity CC.** WACC (the weighted average cost of capital on debt and equity) works just as well without a CAPM. Debt often provides cheaper project financing than equity, especially for firms that have use for the corporate income tax shelter that debt provides. For example, a building may be financed by a conforming mortgage covering 80 percent of the cost at 6 percent a year, or a jumbo mortgage covering 90 percent at 7 percent a year. If the cost of equity capital remains approximately 10 percent a year regardless of capital structure, the CC is 6.8 percent with the conforming mortgage and 7.3 percent with the jumbo. For a firm in a 60 percent corporate income tax bracket, the WACC is 4.88 percent for the conforming and 4.78 percent for the jumbo.

Using the same CC for equity regardless of leverage creates a puzzle: Why would the cost of equity not be higher in the more levered capital structure? The residual equity is much riskier in the jumbo capital structure than in the conforming one. Yet, although the investors should care, the empirical evidence for our publicly traded stocks suggests that they do not. They have not demanded or received sufficiently better terms to compensate them for the higher risk of the more levered equity. No one understands why.

**Factor Adjustments**

Although market-beta does not predict expected equity returns, there are other analogous methods that do. From a zoo of similar regularities I have chosen four empirical regularities that [1] make sense to me and [2] have persisted for a long time. These are good candidates for judging the informal CC of equity adjustments.

3. **Market Cap Adjustment: Smaller firms have to offer higher average returns.**

Market cap may be used as a proxy for a lot of different attributes, perhaps the most important being access to perfect capital markets. Smaller firms can often obtain capital only on worse terms than larger ones. From 1995 to 2018, the average publicly-traded firm in the bottom 30 percent by market cap (averaging about $300 million in 2018) returned a geometric 10 percent per year. Firms in the top 70 percent returned only about 9 percent per year. So the market cap spread was about 1 percent. Although we do not have systematic data from which to estimate the historical spread for small non-publicly traded firms, it is
We do not understand why riskier stocks have not offered higher average returns, but it seems to be mostly a phenomenon internal to the stock market. Over the last fifty years, stocks overall have outperformed risk-free government bonds by about 2-3 percent a year, and bills by 4-6 percent. Projects that look more like debt investments (and financing that is more debt-like) should thus be assumed to have a lower CC than equivalent projects that look like equity.

**Investor-Specific**
Models like the CAPM assume perfect capital markets: All investors are alike and compete, so only the project characteristics matter. This view is often too simplistic. Instead, it seems that the CC depends on both project supply (their future cash flows) and project demand (available investor capital).

7. **Relevant Exposures: The appropriate CC depends on the investor.**
For example, outside capital may not be competitively available to entrepreneurs whose entire wealth is in their firms. For them, it doesn’t even make sense to think of their CC in terms of covariation (beta) with the stock market. Instead, what matters to them is their firm-specific risk exposure, measured by the variance or volatility. Investor heterogeneity can also be caused by preferences or tax status. Tax-exempt investors should have a lower CC and therefore offer capital at lower prices.

Whether investors differ because of risk aversion, preferences, or tax bracket, the appropriate CC must reflect not just the project, but the specific situation of the owners. Valuation is far more difficult when a single project may have a CC of 5 percent for one investor and a CC of 10 percent for another.

**Analysis-Specific**
Along with these specific technical recommendations, I want to close with some general analysis advice. By necessity, this is even more vague than my preceding suggestions.

8. **Conflicts of Interest: Know others.**
Many bad capital-budgeting inputs and outputs occur because someone (you?) wants to arrive at a particular answer. If your input estimates come from someone who has a conflict of interest, do not trust them. Estimates from employees, lawyers, investment bankers, and so forth are rarely unbiased. Think about what’s in it for them. Solicit advice from various parties, ideally ones with opposite motives. Consider hiring a devil’s advocate consultant, tasked with talking you out of whatever course of action and cost of capital you prefer. And be warned: You may not like what you hear.

9. **Judgment Errors: Know thyself.**
We are all overly optimistic, but admitting we have a problem is the first step to recovery. The most important factor, and perhaps the most obvious, is forgetting the realistic probability of utter failure and so incorrectly judging the most likely outcomes. For each 1 percent probability that a pandemic, earthquake, fire, plane crash, or employee death will wipe out entire projects, the internal rate of return for the project will be 1 percent lower. Recognizing common human biases can sometimes justify conservatively increasing project investment hurdle rates to exceed the CC.

Many managers, especially pessimistic ones, like scenario analyses which help them incorporate potential failures into their estimates. I am skeptical about
the usefulness of these analyses for CC assessments, though not for expected cash flow assessments. I do not know of a way to effectively use bad scenarios in a formal decision process.

10. **Humility: CC assessments for non-trivial projects have low accuracy.**

Except for fixed-income investments, the most important prescription for assessing the CC may well be humility—a quality that does not come easily to either practitioners or finance professors. Even the best CC estimates are rough. It is cold comfort that the CC estimates in the NPV denominator are still usually better than the expected cash flow estimates in the NPV numerator when you need both to be sound. Sensitivity analyses can help you understand the project better, but we don’t really know how to incorporate them appropriately into our decision processes, either. It may be better to adopt a pessimistic view than the average one.

I close with the observation that, while students often believe that theory is more difficult than practice, unfortunately, the opposite is true.

**A Speculative Capital-Structure Theory with Capital-Budgeting Implications**

In a Modigliani-Miller (M&M) perfect capital market, the overall WACC remains the same regardless of capital structure. Mathematically, a capital structure with more leverage has a higher cost of debt and a higher cost of equity but tilts the weighting from higher-cost equity towards lower-cost debt. Of course, the Modigliani-Miller world is primarily a thought experiment.

When the capital markets are not perfect, firms can minimize their WACC by choosing the best capital structure—the one that minimizes their tax obligation, moral hazard and agency conflicts, adverse information disclosure, transaction costs, etc. Nevertheless, the M&M indifference prescription remains surprisingly accurate as long as debt is less than, say, half of the firm’s financing. This works because WACC tends to be very insensitive to modest levels of leverage. Put differently, it matters little whether a firm chooses a capital structure of 10 percent debt or 30 percent debt; the WACC typically remains about the same.

Fine-tuning their optimal choice of leverage really matters only for firms that are high-leverage (say, 80 percent or more), such as financial services firms, firms near financial distress, or firms in leveraged buyouts.

As shown in Figure B above, the empirical evidence for large publicly traded firms suggests that the expected rate of return on equity does not increase with market-beta and leverage. What does this imply to an enlightened manager about optimal capital-structure and WACC?

Of the three effects of leverage (higher CC on debt, higher CC on equity, more weight on the debt component) only the first and last remain. The WACC then decreases as long as the expected rate of return on marginal debt remains below the expected rate of return on equity. Managers can thus obtain the lowest WACC with a capital structure in which the expected rate of return on debt is equal to the (roughly constant) expected rate of return on equity on the margin. (The average cost of capital on debt should be lower.)

To the extent that managers care only about equity returns (if only because debt default could get them fired), and if the debt comes from external capital providers (and not from the equity holders themselves), they can follow an even simpler rule. They can compare the quoted interest rate on debt to the expected rate of return on equity, and use debt financing until the two become equal. If they pursue this capital structure policy, then all three rates are the same: the CC for capital budgeting purposes, the quoted rate of return on debt, and the expected rate of return on equity. This equal cost of equity capital structure theory has clear flaws, but it may be more realistic and useful than its competitors. The evidence will tell.

While students often believe that theory is more difficult than practice, unfortunately, the opposite is true.

To many managers who already have an intuitive understanding of their own ignorance, the flaws in the CAPM may not be news. Such managers tend to err on the side of caution. Jagannathan et al showed that firms, on average, reported using twice their own estimated CC as their hurdle rates! So even firms with abundant access to capital may prefer to forgo many profitable projects.

**Ivo Welch** is the J. Fred Weston Professor of Finance at the UCLA Anderson Graduate School of Management, a 2015 Humboldt fellow, editor of the Critical Finance Review, and author of a free corporate finance textbook. His published work has been highly influential both in finance and economics. His current research agenda focuses on the estimation and uses of market-beta.
Endnotes

1. The shorter bill rate should be used for short-term projects in both the risk-free rate and the equity premium, and the long-term bonds rate for long-term projects. A more detailed discussion (with information about data) appears in Part II of my free corporate finance textbook at book.ivowelch.info.

2. The best-known estimator of market-beta is also one of the easiest. It is explained in Welch (2019) available on SSRN, 3371240.


4. Finance professors usually lack a sense of humor.

5. From 1962 to 2018, small stocks offered an even higher 1.5 percent per year bonus spread over large stocks. The compound rate of return reflects not only the arithmetic mean, but also the volatility. For example, projects with a volatility of 20 percent offer 2 percent lower rates of return than projects with 0 percent volatility.

6. Interestingly, within stocks, there is some evidence that riskier stocks have not outperformed. (Besides, anyone who can predict equity performance should quit corporate practice and work for a hedge fund. This sort of predictive capability has exceeded that of even the most sophisticated finance professors.)

7. My quoted costs of capital are context specific, but they are also lower than those often quoted. This is primarily because a geometric equity premium of 1-3 percent per annum with respect to long-term bonds over long horizons is a reasonable estimate, equivalent to an arithmetic premium of about 3-5 percent.

8. In short, my advice is to thoroughly understand the problem. I do not advise you to succumb to inertia through endless analyses and committees.

9. A manifestation of this lack of humility is the frequent occurrence of equity CC estimates quoted as percents with several digits after the decimal point. Outside of fixed-income cash flows, such pseudo-precision is laughable. We have nowhere near the ability to assess CC at better than 1% intervals.

Give Yourself a Nudge to Make SMARTER BUSINESS DECISIONS

Ralph L. Keeney
Fuqua School of Business, Duke University

Ralph Keeney offers innovative concepts and practical guidelines for making smarter business decisions. They will help you to determine and define the decision you need to make, identify the complete set of objectives which your decision should achieve, and create a range of high-quality alternatives. Learn these skills to obtain the ultimate business advantage: making smarter decisions.

Decision making should be considered the primary management skill because the only way you can purposefully improve your business is through the decisions you make. If you want to introduce a new marketing campaign, nothing happens until you decide on and enact a specific strategy. If you want to manage your cybersecurity more effectively, nothing happens until you identify the threats and decide how to address them. If you are choosing a new CFO, all the effects take place after the decision is made.

Making excellent decisions is challenging. Some executives and managers, especially those who have earned MBAs, have taken courses that included decision-making techniques. But following prescriptive rules to guide your decision can be complicated and slow, and most managers have neither the background nor the time for a formal evaluation of alternatives. You can hire decision consultants, but they tend to be expensive and time-consuming. So most business decisions are made using an intuitive decision process, rather than a systematic evaluation. Our intuitive decision-making processes are based on ingrained habits that we have developed over time. When something occurs that requires a decision, we react. Our initial thinking to solve that problem is to find a ‘solution’. If the first alternative that comes to mind will solve the problem, we usually select it. Otherwise, we think a bit more to find an alternative that will solve the problem. I call this process alternative-focused decision-making, which
is severely limiting if your purpose is to make high-quality decisions.

How can you arrive at a quality decision if you have not first identified all of the objectives that characterize quality for that decision? How can you create quality alternatives without thoroughly understanding what quality means to you? How can you create quality alternatives without thoroughly understanding what quality means to you? How can you make a quality decision if you haven’t examined a desirable set of alternatives? Intuitive decisions essentially neglect the front-end elements of a decision process that systematically addresses these three factors which are the key to improving the quality of your business decisions. The good news is that we can all improve our decision-making and thereby improve the success of our businesses. The better news is that you can learn the concepts and procedures necessary to do this and that they are practical to use.

The Importance and Uses of Nudges

Over the past few decades, psychologists and behavioral economists have identified numerous biases that erode the quality of everyone’s decisions, including executives and managers and me. Behavioral economists have demonstrated that the decisions we make are influenced by the way the alternatives are presented to or framed by the decision-maker. For example, when considering whether to make an important change concerning how a business operates, we feel a strong bias to maintain the status quo.

Thaler and Sunstein, authors of the book *Nudge*, present numerous decisions for which individuals, using their intuitive decision processes, select inferior alternatives that negatively affect their lives. They define the term ‘nudge’ as any aspect of the presentation of a decision to a decision-maker which is designed to improve the chances that the decision-maker will select the alternative that best achieves his or her interests. They also demonstrate that nudges significantly influence us to make better decisions.

Until now, the concept of nudges has only been applied to decisions for which some organization, such as a government agency, has the responsibility to present alternatives from which someone else must choose. Over the last decade, numerous authorities throughout the world have used nudges, influencing millions of people to make better decisions about nutrition, retirement savings, traffic safety, pollution, and going to college. Your business decisions are not guided by any external organization or individual. Only you can generate or collect useful information about the decisions you face to improve the quality of your choices. Each piece of useful information influences your perception of the decision. That information constitutes part of the presentation of the decision to you, the decision-maker, and nudges you toward a smarter decision. Such nudges are consistent with Thaler and Sunstein’s definition of a nudge since the presentation of that information helps you, as the decision-maker, to make a smarter decision.

One key to making a smart business decision is to clearly state all of your values for that decision.

One key to making a smart business decision is to clearly state all of your values for that decision. Each stated value is a nudge. Collectively, they define everything pertaining to that decision that the business cares about. All subsequent steps in your decision-making process should pursue these values. I call this process *value-focused decision-making*. Value-focused decision-making helps you to develop insightful nudges which improve your decisions.

The nudges discussed here are rooted in a clear articulation of the three fundamental front-end elements that structure any decision: defining the decision, identifying the objectives you want to achieve, and creating an appealing set of alternatives. Collectively these elements frame your decision as illustrated in Figure 1. This frame precisely describes your decision, helping you to select the alternative from those identified that best achieves the stated objectives. The frame also defines any additional information that you may need to make a sound decision, such as the projected consequences of each alternative. These descriptions provide a sound basis for evaluating

---

**Figure 1: Your Decision Frame**

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Alternative A</th>
<th>Alternative B</th>
<th>Alternative C</th>
<th>Alternative D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
the alternatives and also nudge you toward smarter decisions.

Once you have completed the fundamental front-end elements of a decision, it will be clear what must be done to describe the consequences and evaluate your alternatives, the back-end elements. The front-end work that goes into a decision has a much greater influence than the back-end work. A quality front-end

• defines unambiguously the decision you should face, so that you don't waste time and effort solving only part of the problem or making the wrong decision,
• specifies everything you want your decision to achieve, improving your chances of achieving it,
• identifies better alternatives for your decision than those you initially recognized,
• establishes an appropriate basis for your back-end evaluation of the alternatives, and
• provides a logical guide for meaningful and comprehensive discussions about the decision.

Once you have developed a quality frame for your decision, using it to think clearly about the pros and cons of each alternative will provide the basis to make a sound and justifiable decision. For complex business decisions, this frame is the foundation for a quantitative evaluation of the alternatives that explicitly incorporates the relevant data, uncertainties about the possible consequences, and the associated value trade-offs of the decision. As most decisions will not include any detailed back-end analysis of the alternatives, a quality front-end is particularly vital.

Defining Your Decision

Once you recognize a problem or opportunity for your business, you must make a decision to address it. Creating a decision statement is the first step in a value-focused decision process. Your decision statement should describe clearly and concisely what you want to decide. This statement is a nudge because it is the basis for your detailed thinking about the next two elements, specifying your objectives and creating a set of promising alternatives.

In stating the decision that you intend to face, one simple rule is very helpful: begin with the word decide, generally followed by which, what, when, where, how, or if. For example: ‘Decide which of three companies to partner with on a given activity,’ or ‘Decide where to build our new manufacturing facility.’ Anyone who reads a good decision statement should be able to understand the decision under consideration. In composing decision statements, avoid the three common shortcomings of being ambiguous, having too narrow a focus, or describing the wrong decision.

Never simply accept a decision statement as you initially conceive it. You have a choice, actually a decision in itself, about how to express the decision you face. It is often useful to develop several potential statements of your decision and to thoughtfully consider which best describes it. Once you’ve chosen the best one, try to make it better.

Decision statements which take the form of ‘decide whether to do something’ are often ambiguous. Consider the statement ‘decide whether to select company X as the supplier of a key component of your major product.’ This statement is not adequate because it gives no indication of what not selecting company X entails. It is impossible to evaluate the relative desirability of selecting company X without knowing what the other alternatives might be.

A broad decision that you did not explicitly recognize is often composed of a series of narrower decisions. By addressing these separately, the collection of the best alternatives for the narrower decisions constitutes the alternative for the broader decision. But sometimes, the result is a poor choice for that broader decision. In composing your decision statement you should be sure to address the broader decision.

Years before the coronavirus pandemic, many companies considered allowing employees to do part of their work from home. Initially, different managers who received such requests probably made their decisions for different reasons. As such requests became more common, companies realized it would be better to establish a policy rather than considering each request separately. They would have to consider policy alternatives in terms of the criteria for allowing employees to work from home, procedures for evaluating the quality of work done remotely, and guidelines for revoking permission to work at home if necessary. Following a policy requires much less management time than addressing each request separately and facilitates making consistent decisions.

Sometimes when a problem occurs, we rush to solve it without carefully defining the decision that should be faced. The result of this haste may be making little headway with the real problem and, sometimes, disaster. Consider the case of a company that had produced a relatively new high-quality, expensive, and profitable consumer product, but before it became well established, the national economy went into recession and some consumers became more cost conscious. The company’s sales of the product dropped, and within two years, were so low that the product was barely profitable. A marketing study
informed the division manager that consumers who had stopped purchasing the product were discouraged by its relatively high price. The manager concluded that the company needed to reduce the cost of the product.

Her team suggested various ways to cut product costs and they chose the one that seemed best. Sales stabilized for the next six months, but then began to drop again. New market research concluded that the remaining loyal customers, who were not particularly cost-conscious, had stopped purchasing the product because its quality had declined. In less than a year, the product’s sales were too low to maintain production. A post-mortem study concluded that the company had addressed the wrong decision by considering only cutting costs to regain lost customers and attract new customers.

The manager should have taken the time to carefully consider which decision she should be making. Her decision statement might then have been ‘decide how to increase the profitability of our product,’ a far broader statement than the one focused only on cutting costs. It would have included, for instance, investing in advertising, improving product quality, streamlining operations, raising the price, and the possibility of other profitability management options. With a nudge from this broader decision statement, the company might have made its original premium product profitable again.

When you compose an important decision statement, it is best to consult all the professionals who will be involved. By doing this, you insure that all members of your team feel included and that thoughts which have merit are heard. It is also the first step in building the team that will work on the decision. It sets the stage for the rest of the decision process, which will progress more smoothly if it is rooted in a definition of the decision that everyone agrees on.

Identifying Your Values

Once you define a decision that you intend to face, you should specify what you want to achieve by making that decision. This process is effectively done in two steps. First identify everything that you care about in making that decision. I refer to anything that you care about as a value.

A manufacturing manager who has composed the statement “decide how to manage the solid waste from our manufacturing process” might list values including efficient manufacturing, reducing waste in landfills, the cost of managing the waste, and the environment.

Identifying values for your decision requires creative thought. When you begin thinking about the values for a decision, anything that comes to mind is likely to be either a relevant value or the basis for one. Describe these values in the way that makes sense to you. Using specific guidelines to identify values can restrict the creative thought process by diverting your attention away from what you do care about and toward considering whether a particular thought ‘counts’ as a value. This limitation could leave you with an incomplete set of values.

Once you have created the list of values for your decision, state each value as an objective.

Once you have created the list of values for your decision, state each value as an objective. Phrase each objective in the common format of a verb and an object to clarify the meaning of that value.

In the manufacturing waste example, objectives for the first three values listed might be described as ‘reduce the amount of waste generated,’ ‘minimize landfill material,’ and ‘minimize cost of treating the waste.’ The environmental value might be better described by two objectives: ‘minimize short-term damage to the environment’ and ‘minimize long-term damage to the environment.’ Each objective nudges you toward smarter decisions. Conversely, if you fail to identify one of the relevant objectives, you are more likely to select an alternative that performs poorly in that area.

When facing an important decision, most of us believe that we know our values and would need only a couple of minutes to make a corresponding list of objectives. This is rarely true. Many consulting experiences and several scientific experiments demonstrate that when we initially list our objectives for a significant business or personal decision, we tend to miss important objectives.34

Identifying Objectives for an MBA Internship

A full-time MBA program usually consists of two academic years with an internship in the summer between. The internship is particularly important because it helps students to discover their preferred field and sometimes leads to employment after graduation. As part of a homework assignment, the 295 students of an MBA class at a respected university were asked to list all of their objectives for their internships. Beforehand, my colleagues and I generated a master list of thirty-two objectives that an MBA student might want to consider in choosing an internship. After the students reported that their lists of objectives were complete, we gave them our master list and asked them to check all of the objectives that were appropriate to them. Next we asked them to match objectives from their own lists to the
corresponding objectives on the master list. On average, the students’ lists consisted of 6.4 objectives, yet they selected an average of 20.1 objectives from the master list. Although they were seriously trying, the students’ initial lists included only 32 percent of their actual objectives for one of the most important decisions they would face during their MBA years.

One possible explanation is that the students initially listed their most important objectives and those they subsequently selected from the master list were much less important. To test this idea, we asked the students to rate the relative importance of each of their objectives on a scale from 1, meaning very low importance, to 9, meaning very high importance. The average rating they gave objectives from their own lists was 7.28, whereas the average rating for objectives selected from the master list was 7.23. The responses showed essentially no difference in importance between the two categories. The implication is that almost all the students who participated, most of whom are now managers or executives, did not recognize many of their own objectives for a decision they considered to be very important.

Step 2. Value Stimulation Techniques. Table 1 demonstrates several techniques you can use to identify additional values. They will help you to generate useful nudges. You can find further details on how to apply these techniques, as well as examples, in my 2020 book.  

Step 3. Ask Others to Suggest Values. Friends, colleagues, and advisers can offer insight about your decisions. Just ask them, “What considerations would you take into account in making this decision?” You might also ask them to suggest pros and cons of your alternatives. These pros and cons could themselves suggest values you had not recognized. You might ask directly, “What do you think I should do?” If they have a definitive response, ask how they reached that conclusion. If you are facing a specific decision for the first time, it is particularly useful to talk to people who have faced similar decisions.

Step 4. Use Previously Identified Values. Values that you have already articulated for a decision are a useful source for uncovering additional relevant values.

| Table 1. Techniques to Help Identify Appropriate Values for Business Decisions |
| Technique | Questions |
| Alternatives | Describe a hypothetical perfect alternative, a terrible alternative, some reasonable alternatives, and the status quo. What is good or bad about each? |
| Emotions and Feelings | Articulate the emotions which your decision evokes. Why do you care about these emotions and how do your alternatives affect them? |
| Consequences | Think about what might occur as a result of your decision, focusing on particularly good or bad consequences. |
| Goals and Constraints | Review any goals and constraints that influence your decision. What are your reasons for them? |
| Different Perspectives | Suppose a colleague or a competitor faced this same decision. What would their values be? If you faced this same decision at some time in the future, what would concern you? |
| Strategic Values | Consider the strategic values that guide your organization. Do these suggest any values relevant to this decision? |
| Disappointment and Regret | Which potential consequences of your decision might disappoint you? Which might you regret? |
| Generic Values | What were your values for similar decisions in the past? Are they relevant here? |

A Process to Identify Your Values for a Decision.

To address this difficulty in composing a complete set of values for a decision, four simple-to-follow steps are useful. The first is to produce a wish list of everything you can think of that you care about concerning the decision. The second uses several tactics to stimulate your thinking and expand the list. The third is to ask others for suggestions. And the fourth uses the values you’ve already listed to help you search for any that might be missing.

Step 1. A Wish List. Your decision statement will focus your thoughts about the values for that decision. Include any idea that comes to mind on your wish list; you can always delete it later if you decide it’s not relevant. Do your own thinking first. Asking for suggestions before you have thoroughly considered your values may anchor your thinking to the ideas of others and lead to serious omissions. When you feel you’ve run out of ideas, challenge yourself to add a few more and you probably will. Take a break and return later; you may identify still more of your relevant values.

Step 2. Value Stimulation Techniques. Table 1 demonstrates several techniques you can use to identify additional values. They will help you to generate useful nudges. You can find further details on how to apply these techniques, as well as examples, in my 2020 book.

Step 3. Ask Others to Suggest Values. Friends, colleagues, and advisers can offer insight about your decisions. Just ask them, “What considerations would you take into account in making this decision?” You might also ask them to suggest pros and cons of your alternatives. These pros and cons could themselves suggest values you had not recognized. You might ask directly, “What do you think I should do?” If they have a definitive response, ask how they reached that conclusion. If you are facing a specific decision for the first time, it is particularly useful to talk to people who have faced similar decisions.

Step 4. Use Previously Identified Values. Values that you have already articulated for a decision are a useful source for uncovering additional relevant values.
Use three simple questions: “what do you mean by that value,” “why is that value important,” and “how can you achieve that value.” Suppose you have several job offers and need to choose one. You have listed your initial values as interesting work, a good salary, and convenience. Asking yourself what you mean by interesting work may suggest working on substantial issues, making significant contributions, having enjoyable coworkers, and avoiding involvement in legal and regulatory affairs. Considering how your work could be more interesting might lead you to values such as interacting professionally with people in and outside the company, the desire to travel on business, continuous learning, and not being at a desk all day.

**Objectives for Group Business Decisions**

Business decisions are often made by more than one person. In making such decisions, it is useful for each person to separately list the values that they think are important. As well as producing a broader collective list of values, this method increases the chances that everyone will really think about what the decision should achieve.

Next, create a combined list of values. In doing this, inquire about the meaning of stated values; individuals often use the same words for different values and different words to express the same value.

Once you have a complete list of the business’s values, members of the group should collaborate to state each value as an objective. This process will ensure that everyone understands the meaning of each value and its relevance to the decision. Now you have an agreed-upon set of values, articulated as objectives, which characterizes the decision and includes the originally stated values of everyone on the team, building their sense of a common purpose.

**Clarifying the Roles of Different Types of Objectives**

Once you have compiled all your objectives for your decision, it is useful to distinguish between two types of objectives: means objectives and fundamental objectives. To discover the fundamental objectives, examine pairs of objectives from your list. If achieving one of the objectives influences, positively or negatively, the extent to which the other objective is achieved, they have a means-ends relationship. The former objective is thus a means objective, and the latter an ends objective. However, that ends objective may be a means objective to some other objective on the list. As an example, maximize sales is a means objective to maximize income, and maximize income is a means objective to maximize profit. A means objective can have more than one ends objective, and an ends objective can have more than one means objective. An ends objective that is not a means objective to anything else is a fundamental objective.

**Distinguishing between means objectives and fundamental objectives simplifies the decision and focuses your attention on what is crucial.**

Distinguishing between means objectives and fundamental objectives simplifies the decision and focuses your attention on what is crucial. Only fundamental objectives should be used to evaluate your alternatives. By including means objectives, which contribute to fundamental objectives, you would end up double counting some of the pros and cons of your alternatives. By eliminating means objectives from your evaluation, you will reduce the number of objectives you have to consider, which makes the evaluation easier and nudges you toward a smarter decision. That doesn’t mean your means objectives aren’t important; each is a stimulus to create new alternatives and improve existing ones.

**Creating Alternatives**

For most decisions, it is important that you put some time and effort into creating your alternatives. You can never choose an alternative has not been identified and the chosen alternative can be no better than the best of those that have been identified. Just creating one new alternative that is better than your previously recognized alternatives constitutes a strong nudge toward a smarter decision. Getting what you want from a decision often depends more on the quality of the alternatives identified than on the quality of your choice between them.

It is true that some decisions don’t require you to work hard at creating alternatives since you can readily list them. If you needed 20,000 square feet of office space in Austin, an inventory of available office buildings constitutes a list of all possible alternatives. For most decisions, however, there is no predetermined list of all the potential alternatives. Creating one requires focused effort.
Pitfalls in Creating Alternatives
There are several common pitfalls which can result in an inadequate set of alternatives.

Not Allocating Time to Create Alternatives. Too often, people fail to grasp the substantial benefit of creating a rich list of alternatives and so devote little or no effort to the endeavor. Instead, they consider only the most obvious alternatives and choose the one that best ‘solves’ the problem quickly.

Stopping the Search after Finding One Alternative. When facing an important decision with no obvious set of alternatives, you naturally begin to search for a solution. If you find one that is good enough, your first impulse is to choose it. But if you do that, you have essentially just decided based on a search process, rather than a decision process. While it is often tempting to select the first solution that comes to mind, remember that once you identify one alternative, it becomes easier to think of a few more. The extra few minutes of effort you put into creating alternatives will probably turn out to be a wise investment.

Thinking Too Narrowly. We rarely push ourselves to think of alternatives that are harder to find. Instead, we choose the low-hanging fruit, the ‘business as usual’ alternatives. If our decisions seem similar to past decisions, we tend to consider the same alternatives as before, perhaps with minor modifications.

Inappropriate Use of Constraints. Constraints are intended to focus our thinking on the realistic alternatives, but they can also seriously limit our thinking. Constraints become a hindrance when they conflict with the individual objectives of the decision. We tend not to consider an alternative that clearly exceeds four of our five constraints, but just misses on the fifth. Yet that alternative may be much better than one that barely meets all five constraints.

A number of experiments have shown that people have difficulty in creating a good set of alternatives for decisions worthy of thought. Although the study participants considered the decisions presented relevant, they were not facing those decisions at the time of the study. Would they still have had serious difficulties in generating alternatives for an important pending decision? The following experiment sought to find out.

Creating Alternatives to Benefit from a Business Internship
Most undergraduate or masters students pursuing a business curriculum at a German university choose at least one internship with a business, non-profit, or government organization near the end of their studies. The purpose is to obtain practical work experience and to improve their future employment opportunities. The internship is generally recognized as an important experience, and students want to benefit as much as possible from their internships.

Before conducting this experiment, a colleague and I developed a list of all the types of alternatives which an intern could use to enhance the quality of an upcoming internship. The master list comprised thirty-one distinct alternatives including: apply skills learned at university, ask a supervisor for a specific project, establish contact with supervisors, contribute to a good work atmosphere, and enhance skills in workshops and training courses.

Over 200 students participated in our study, which consisted of four steps. In step 1, we asked participants to list all the ways they could think of to enhance their internships. In step 2, we gave them a master list of our thirty-one alternatives and asked them to check those they thought would be personally useful. In step 3, participants matched the alternatives from their own lists to corresponding alternatives on the master list. Finally, in step 4, they ranked all of the alternatives they had generated or selected in steps 1 and 2 in terms of significance, defined as the likelihood that they would use that alternative during their internships. On average, the participants created 6.66 distinct alternatives on their own lists and selected an additional 11.27 from the master list. Faced with this important personal decision, most participants came up with only about 37 percent of the possible alternatives which they later selected as useful to them.

Moreover, only 44 percent of the participants’ most significant alternative as ranked in step 4 were on the list they personally created in step 1. Of participants’ top five ranked alternatives, on average only 1.86 were on their original lists.

Focus your search for alternatives where high-quality alternatives might be found and expend no effort in looking where no realistic alternatives exist.

A Practical Process for Creating Alternatives
The conventional advice for finding better alternatives is to ‘think outside the box.’ While the idea behind it is certainly useful, this advice provides no practical guidance on how to find great alternatives. Inside the metaphoric box we generally find standard alternatives that are quite similar to each other. Outside is everywhere else, which tends to be a phenomenally large space to search for anything. It is advantageous to focus your search for alternatives where high-quality alternatives might be found and expend
Traditional brainstorming has two shortcomings for generating alternatives for a decision.

Traditional brainstorming has two shortcomings for generating alternatives for a decision. First, the participants generally work with little guidance about specific objectives for the alternatives. Second, brainstorming usually involves one person at a time speaking while all the others listen. The speaker’s ideas may therefore anchor the listener’s thoughts. It is also difficult to think deeply while either listening or speaking.

Value-focused brainstorming, described in Table 2, addresses these shortcomings. The first three steps are those by which an individual would create alternatives. The first shortcoming of traditional brainstorming is addressed in step 2, which provides guidance for creating useful alternatives. The brainstorming session is framed by the values, stated as objectives, which define the alternatives box. The same participants, or a selection of them, can establish these values in an initial brainstorming session, or the person who convened the session could provide them. Step 3 addresses the second shortcoming of traditional brainstorming by allowing each individual to create alternatives independently before meeting to take advantage of the traditional interpersonal strengths of brainstorming in step 4.

Value-focused brainstorming is useful for business and organizational decisions. One important instance in which I applied it concerned developing alternatives to improve emergency evacuation from large buildings.³

Evacuation from Large Buildings
After the terrorist attacks on the World Trade Center in 2001, one of the federal government’s recommendations was to improve emergency evacuation from large buildings. I facilitated an invitation-only workshop to come up with innovative alternatives. There were over thirty participants knowledgeable about different aspects of emergency evacuation. Collectively, their expertise covered firefighting, architecture, design, building standards, building codes, communications, building construction, materials science, handicapped accessibility, human behavior, and emergency management.

Since the participants all knew a great deal about evacuation, I began by asking each to list alternatives they thought would improve evacuation. I wanted each participant to feel confident that their original ideas would be documented and considered. Collectively the group suggested 221 alternatives. In keeping with the process described above, I next asked them to list all of their values regarding the evacuation of buildings and then to state each those values as objectives, which allowed us to understand and combine them more readily. Thirty-two people submitted 361 objectives, some of which, such as “save lives,” appeared on many lists. On the first evening, two colleagues and I compiled a comprehensive list of all the objectives. We organized them into nineteen major objectives such as save lives, minimize property damage, enhance communication, increase safety, and improve education and training.

<table>
<thead>
<tr>
<th>Table 2. Steps of Value-Focused Brainstorming</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. State the decision to be solved.</td>
</tr>
<tr>
<td>2. Identify the values of the decision.</td>
</tr>
<tr>
<td>3. Individually generate alternatives.</td>
</tr>
</tbody>
</table>

3. Steps of Value-Focused Brainstorming

Rooted in the idea that groups of people should have more ideas than one person, brainstorming is a well-known means of generating ideas. Brainstorming involves a group working together to generate ideas and traditionally fosters creativity by welcoming all ideas and refraining from evaluation during the generation process.⁴

no effort looking where no realistic alternatives exist.

To focus your effort on creating good alternatives, you definitely want to think outside the box, but not outside just any box. Instead, think inside the alternatives box. For every decision, there is a box of the right size which contains all realistic alternatives for that particular decision. The alternatives box is much larger than the inside of the proverbial box and much smaller than the world outside.

The purpose of any decision is to best achieve our objectives. It is therefore legitimate to consider any alternative that contributes to achieving any of the stated objectives for a given decision. The alternatives box is therefore delineated by the stated objectives of a given decision. The objectives guide us in creating realistic alternatives.

Any objective can nudge you toward an innovative alternative for your decision. Consider each objective separately and try to identify alternatives that would help you achieve it. Next, use pairs of objectives, and then larger subsets of objectives, to stimulate your thinking. After having conceived of several distinct alternatives, produce more by finding aspects of your existing alternatives that can be combined. These procedures will help you to search the entire alternatives box without wasting your time on searching outside it.

Value-Focused Brainstorming
Rooted in the idea that groups of people should have more ideas than one person, brainstorming is a well-known means of generating ideas. Brainstorming involves a group working together to generate ideas and traditionally fosters creativity by welcoming all ideas and refraining from evaluation during the generation process.⁴
On the second day, I asked the participants to use these major objectives to create alternatives that would facilitate evacuation. They generated a further 179 alternatives by using the nudges offered by their objectives in the value-focused brainstorming. On the third morning, we investigated whether alternatives created by the value-focused brainstorming were innovative and of high quality. Nine separate groups of two to four participants conducted a preliminary evaluation of the same selected set of thirty-seven alternatives created in the brainstorming session. They used three criteria for this evaluation: usefulness, defined as contribution to improving evacuations, feasibility of implementing the alternative within ten years, and creativity, on a scale ranging from a well-known alternative to one that was completely new. We found that some of the most useful, feasible, and creative alternatives were previously unknown to this very experienced group. This finding demonstrates that using values to nudge the brainstorming processes can produce some very desirable alternatives, even among experienced and knowledgeable professionals.

Few people have been practically trained in making decisions, and fewer still have considered deliberately practicing decision-making skills.

Practice is Important
To become proficient in any skill, you must first learn to perform the necessary actions, and then you must practice them. Few people have been practically trained in making decisions, and fewer still have considered deliberately practicing decision-making skills. This article has introduced you to the tasks you need to pursue to thoroughly understand the decisions you face and described practical procedures to help you effectively accomplish them. You will not get enough practice using your newfound skills if you use them only for your important business decisions. Not only are such decisions few and far between, they also involve intertwined complexities which make it difficult to practice your basic skills. Fortunately, we all face many less important decisions, both business and personal, which provide a rich practice ground. You can strengthen your grasp of the concepts and procedures that will improve your decision-making skills by using them on these decisions. In the process, you will also make these decisions more wisely.

With practice, you will master creating useful nudges by using value-focused front-end decision skills to structure the decisions you face. These nudges will lead you to make smarter decisions. As you begin to reap the benefits, this way of thinking will start to feel natural when you face decisions, becoming a habit as you become more proficient. You will learn to quickly focus on the values that matter in any decision and achieve those values by developing appropriate nudges to make smarter decisions.

Ralph L. Keeney is a consultant and lecturer on making quality decisions. He has been a professor at MIT, the University of Southern California, and Duke University and has created and managed the decision and risk analysis group in a consulting firm. He is an author of several books and a member of the National Academy of Engineering.

Endnotes
GLOBAL LEADERSHIP IN PRACTICE, RESEARCH AND TEACHING

The Merrick School of Business is focused on the future and dedicated to making an impact on the business world—in Baltimore and beyond. Our students have a tenacity that shines in their persistence to work hard and follow their ambition to move their careers forward. Our commitment as a leading professional school is to create knowledge that advances practice, research and teaching.

Congratulations to the founding editorial team of the Management and Business Review for launching this impressive journal, especially to Kalyan Singhal, professor of operations management, University of Baltimore.

1st
UB launched the world’s first fully online AACSB accredited MBA program in 1999.

45
UB’s rank among the top 100 public institutions for return on investment, according to a Georgetown University study.

25
average class size for undergraduate and graduate courses

9
consecutive years U.S. News & World Report has ranked UB’s online MBA program as a top program—more than any other Maryland institution.

4

1,500
academics and practitioners, representing 30 countries, participated in “best practices in management education” webinars hosted by UB business faculty through the Academy of Management.
FUELED BY PURPOSE
How Analytics Allowed the FCC to Save $7.3 Billion by Auctioning Underused Television Spectrum

Subodha Kumar
Temple University
Using an auction informed by analytics, the US Federal Communications Commission reallocated underutilized portions of the television spectrum. The revenue from this auction exceeded its cost by $7.3 billion, which went toward US deficit reduction. Subodha Kumar summarizes the Kiddoo et al. report on this groundbreaking work which won the 2018 INFORMS Franz Edelman Competition.

Wireless devices use a range of radio frequencies (referred to as the radio frequency spectrum) to receive and transmit information. The Federal Communications Commission (FCC) manages the United States radio frequency spectrum by licensing various portions of these frequencies for specific uses. Because it can be used by many technologies, including wireless services and mobile broadband, the set of radio frequencies which has traditionally been allocated to television operators is extremely valuable. Meanwhile, advances in technology have allowed television providers to maintain the same quality of service while using a smaller portion of the wireless spectrum. Kiddoo et al. documented how the FCC employed analytics to reallocate the underutilized portion of the television spectrum.

Over several years, beginning in 2010, the FCC conducted the world’s first two-sided incentive auction between television broadcasters and the wireless industry. The wireless industry paid $19.8 billion for new licenses. Television providers received $10 billion to relinquish their licenses and $1.75 billion more to move to the new frequencies. And $7.3 billion went back to the federal government to reduce the deficit. Beyond these tremendous financial benefits, taking control of a contiguous portion of the spectrum allows wireless services to increase their innovation as well as the capacity of the nation’s wireless networks.

And $7.3 billion went back to the federal government to reduce the deficit. Beyond these tremendous financial benefits, taking control of a contiguous portion of the spectrum allows wireless services to increase their innovation as well as the capacity of the nation’s wireless networks.

(determining the wireless carriers demand). The auctions also included a repackaging process which assigned bands to TV channels that did not choose to relinquish their bands.

The auction process was, of course, subject to many interdependent constraints. To overcome these challenges, the FCC used analytics. The commission had to find ways to repack the remaining television stations into smaller spectrum bands without interfering with nearby stations, ensure international coordination throughout North America, and determine the clearing target (the total amount of spectrum to be reallocated). To do so, it designed a customized series of optimization models, decompositions, cuts, heuristics, and large neighborhood searches.

The FCC also used a feasibility checker to ensure good economic outcomes, determining whether any active bidder could feasibly be repacked with the existing and non-participating stations. They used a tool called a Sequential Model-based Algorithm Configuration which used machine learning, informed by the previous model, to select the best path forward. The FCC was thereby able to repurpose as much of the TV spectrum as possible while preserving the coverage of TV stations that chose to remain on-air after the auction and ensuring international coordination with neighboring countries.

In the end, the auction repurposed 84 MHz of the spectrum and produced a gross revenue of $19.8 billion. After costs, the roughly $7.3 billion surplus revenue was returned to the federal government in the form of deficit reduction. The auction also made critical bands of the spectrum available to meet the growing US demand for wireless data, which in turn helped to create jobs throughout the country.
To lead such a diversity of interests, including consumers, policy makers, and industry, to agree upon and accept a solution without the use of modern analytical tools would have been nearly impossible.

This use of analytical tools has lasting implications and lessons for managers and policymakers, not only in telecommunications, but also in related industries. One of its key goals was to efficiently match supply against demand. Other industries, such as healthcare and hospitality, face similar apparent mismatches between supply and demand and might profitably employ a similar process.

The FCC first changed its auction practices in 1994, when it implemented simultaneous multiple-round auctions. Kiddoo et al. demonstrate that the FCC has continued to innovate. Its methodology in this case effectively redistributed excess resources from one industry to another in such a way as to benefit both parties, the country, and American society as a whole.

Subodha Kumar is the Paul R. Anderson Distinguished Chair Professor and the Founding Director of the Center for Business Analytics and Disruptive Technologies at Temple University’s Fox School of Business. He is also a board member for many organizations. He has published dozens of articles in respected journals and conferences and is co-author of a book as well as many chapters and cases. Kumar has held several editorial positions and is currently Deputy Editor of Production and Operations Management and Executive Editor of Management and Business Review. He holds a robotics patent and is routinely cited in the media.

Endnotes

Reimagining Capitalism.

Rebecca Henderson, Harvard University

If we are to solve the great global problems of our time, the private sector must play a major role in driving the systemic changes we need. Climate change and inequality are public goods problems – symptoms of a world that has lost the will to focus on the common good and the long term. We will not solve them until we rebuild the political center and the institutions of a truly free society: the rule of law; an honest and independent media; transparent, responsive, and capable government; and an open and inclusive democracy. The business community has both a moral obligation and an economic incentive to move beyond its single-minded focus on shareholder value and towards a broader concern for the health of the economic, social, and institutional systems on which we all rely. Such a shift in focus would enable the private sector to play an active role in building a just and sustainable society.

Making Strategy Execution Work With Cascading Trees.

Christoph Loch, Cambridge Judge Business School, University of Cambridge; Stylianos Kavadias, Cambridge Judge Business School, University of Cambridge; B. C. Yang, Sinyi Realtors and Fu Jen Catholic University Taipei.

Strategy cascading describes the translation of strategies and goals into more specific organizational actions in order to achieve desired results. Cascading requires a formal structure conducive to top-down alignment (in which the actions support the strategy), bottom-up tailoring and innovation (in which the actions modify the strategy), and horizontal coordination (in which interdependent actions in several areas are mutually adjusted to meet overarching goals). The tools used to address the complexity associated with strategy cascading have been, until now, too formulaic, rooted in cascading top-down indicators or generic dimensions. By using a cascading tree, a tool rooted in total quality management, companies can fully customize cascades to their strategy, allowing for alignment, change, and coordination. The proposed tool has been effective in challenging cascading situations, including a police department and a company that implemented an ethical strategy with a range of stakeholder-oriented requirements.


Dave Ulrich, Ross School of Business, University of Michigan and The RBL Group

The organizations where we live, work, play, and worship affect every part of our lives. Organizations turn individual competencies into collective capabilities, isolated events into sustained patterns, and personal values into collective values. In short, organizations matter in our lives. The definition and logic of organizations has evolved over time. Today they are less about hierarchy, systems, or capabilities, and more about creating what we have begun to call market-oriented ecosystems (MOE). The logic of MOEs starts outside in, by identifying market opportunities and then allocating resources in response to them. By allowing their answer to “what is organization” to evolve, leaders, employees, customers, and investors will be better able to improve their organization’s experiences.

Pay for Performance: When Does it Fail?

Nirmalya Kumar, Singapore Management University & INSEAD Emerging Markets Institute; Madan Pillutla, London Business School

Leading scholars of social psychology have concluded that pay for performance has a detrimental effect on human motivation. Both the Harvard Business Review and one of the most popular TED Talks have popularized
their conclusion, that managers should avoid rewarding people for specific accomplishments. Nonetheless, the prevailing compensation systems of most companies have rejected this view. We argue that these broad conclusions about the negative impact of incentives are based on comparatively narrow and specific studies. While it is true that, under certain limited conditions, rewards can reduce performance by over- or under-motivating people, by following our recommendations, managers can avoid creating those conditions.

Over-motivation leads to lowered performance when the increased incentive of possible rewards causes people to “choke under pressure.” Excessive focus on obtaining the rewards can distract people from their work and, in the case of practiced, routine tasks, lead to overthinking. This effect can be ameliorated by providing enough preparation time and reducing procedural accountability.

People become under-motivated when the possibility of rewards leads them to believe that money is the primary motivation for their performance. Managers can prevent this erosion of intrinsic motivation by designing rewards that provide positive feedback about the individual’s competence.

Seizing the Moment: Having Difficult Conversations about Race in the Workplace.

Stephanie J. Creary, The Wharton School, University of Pennsylvania

The incredibly long history of racism, injustice, and discrimination in the United States makes it particularly difficult to address issues of systemic racism. The density of class action lawsuits filed with the Equal Employment Opportunity Commission suggests that federal legislation has not succeeded in ending racism or discrimination. Management research echoes these findings. Black employees face cultural pressures to conform to white Eurocentric standards and norms and are penalized when they do not. Black employees are less likely to attain leadership roles, even when they are qualified. And when they do assume these roles, Black employees are likely to be evaluated less favorably than their white peers. Changing the social relations, structures, and culture of the workplace can help to mitigate the harmful effects of racism on Black employees. Having purposeful conversations about race is also important. To make these conversations more effective, leaders should: R – Reduce anxiety by talking about race anyway; A – Accept that anything related to race is going to be either highly visible or largely invisible; C – Call on internal and external allies for help; E – Expect to provide some “answers,” practical tools, skill-based frameworks, etc.

Leadership as Craft - Crafting New Leaders.

Philip Mirvis, Global Network on Corporate Citizenship and Social Innovation Lab, Babson College; Karen Ayas, The Ripples Business Academy; Jason Grenfell-Gardner, Teligent

We have developed an innovative approach to shaping new leaders by guiding them through three stages of development: apprentice, journeyman, and master craftsman. Our program focuses particular attention on the craft of leadership—combining its rational, aesthetic, and performative qualities. Within our program the CEO and company leaders teach all sessions on industry knowledge; participants interact regularly with exemplary craftspeople, including artists, athletes, actors, chefs, inventors, and leaders; executive mentors provide regular coaching; participants engage in increasingly complex and demanding project-based learning at each phase; and external faculty lead sessions on personal, interpersonal, team, and leadership development. Graduates join a craftsmanship guild in which they, in turn, mentor the next group of participants and help to steward the company’s culture. We use the case of Teligent to illustrate the success of our craftsmanship development program. Teligent is a fast growing generic pharmaceutical maker based in New Jersey with operations in Canada and Estonia. It employs 200 people and has a yearly revenue of $70 million.

Leadership Development: A Psychologically Informed Process That Spawned a Generation of CEOs.

Karol M. Wasylyshyn, Leadership Development Forum; Raj Gupta, Chairman, APTIV PLC and Avantor, Inc. and Former Chairman, Rohm and Haas.

From 1988 to 2008, Rohm and Haas, a global manufacturing company, used a combination of talent management practices and a powerful leadership development process to train its top high potential employees. After the company was sold to Dow in 2009, more than 20 percent of the program’s participants went on to become CEOs elsewhere. We have identified the enduring aspects of this work which could be applied in current leadership development initiatives. These include managerial practices, guiding principles, methodology, and process considerations as well as a focus on the behavioral dimension of leadership, as represented by the construct of emotional intelligence and the long-term relationships participants formed with their executive coach. The active participation of the company’s CEO, which went well beyond funding and imprimatur, was also critical, particularly to the development planning and follow-up stages of this psychologically-informed initiative.
A Manager’s Dilemma: Sow or Harvest.

Vijay Govindarajan, Tuck School of Business, Dartmouth College; Ashish Sood, School of Business, University of California, Riverside; Anup Srivastava, Haskayne School of Business, University of Calgary; Luminita Enache, Haskayne School of Business, University of Calgary; Barry Mishra, School of Business, University of California, Riverside

A manager must often choose between reaping the current profits of existing competencies (harvesting) or creating new competencies which will produce future profits (sowing). By examining how the stock market responds to a firm’s unexpected shift from one strategy to another, we have evaluated this dilemma. Despite the popular view that they are willing, if not eager, to sacrifice long-term value to gain current profit, we find that shareholders do not favor firms’ sudden shifts from sowing to harvesting. Shareholders do, however, favor harvesting value during periods of unusually good performance, when a firm finds sudden success with a product. These findings suggest that a firm must focus relentlessly on building competencies that contribute to long-term value, such as strategy, brands, patents, customer relations, market intelligence, organizational technology, and human capital. Nonetheless, when it finds unexpected success in a given market, it should be prepared to immediately change its focus to reaping the profits.

Adaptive Space: Shifting from Structural to Social Design.

Michael J. Arena, University of Pennsylvania

One of the biggest challenges facing organizations today is the need to be agile in the face of digital disruption. Most organizations weren’t designed to be agile. They grew up in a world where operational efficiency was king. As a result, they create environments in which the ideas needed for digital change are suppressed. Yet people who have accumulated social capital in their relationships are more willing to openly share, debate, and develop ideas. Agility, it turns out, is more social than structural. When workers debate are stifled, so is the firm’s agility. In this era of disruption, social capital is critical if organizations are to adapt in real time. To facilitate this process, leaders must cultivate a deeper understanding of the power social interactions have to foment the flow of ideas, information, and insight. They need to build relational structures which ease the flow of information and resources to enable discovery, development, diffusion, and disruption, the 4D connections of adaptive space. Together, these 4D connections foster the innovative ideas and concepts necessary to positively disrupt.

Learning from the COVID-19 Pandemic to Address Climate Change.

Howard Kunreuther, The Wharton School, University of Pennsylvania; Paul Slovic, Decision Research

The COVID-19 pandemic has shined a bright light on society’s difficulties in dealing with extreme events on a global scale. Few understand the explosive nature of the exponential growth that led to such a vast number of cases, seemingly overnight. Moreover, we tend to be myopic, failing to appreciate the value of undertaking immediate action in order to reduce severe consequences in the future. We are also often unduly optimistic about the probability of adverse events occurring. Because we are inclined to follow the herd, our choices are often influenced by the behavior of others, especially during risk and uncertainty. Decision makers should learn from the coronavirus pandemic and enact the following steps to reduce CO2 emissions and slow climate change: (1) recognize the cognitive biases that impede effective action and decision-making; (2) heed the predictions of experts about the consequences of acting too late; and (3) design a risk management strategy that addresses these biases and heeds expert advice.

Boards and Sustainability: From Aspirations to Action.

N. Craig Smith, INSEAD; Ron Soonieus, Camunico and INSEAD

Boards of directors are vital to firms taking substantive action on sustainability. While prior research has suggested that boards pay little attention to the topic, a recent survey by Board Agenda suggests that many individual board members have ambitious aspirations for sustainability. Unfortunately, respondents also feel that their companies lack the people, knowledge, and tools to take action. We interviewed twenty-five directors from the boards of well-known firms, examining the obstacles to greater board engagement with sustainability, including board members’ characteristics. In analyzing interview responses, we found five distinct archetypes of board member behavior. These profiles help explain the divergence between the attitudes of board members toward sustainability and the frequently inadequate action of the board as a whole. Our findings suggest ways to motivate each type of board member and the value of auditing the knowledge and mindset of board members toward sustainability, offering six approaches to strengthening board engagement with sustainability. While the economic effects of the COVID-19 pandemic might appear to reduce businesses’ ability to become more sustainable, we believe the wise course is to focus on the lon-
The earth keeps getting warmer. Most countries will not meet their Paris Accord commitments. The 2019 climate summit in Madrid ended in bitterness and doubt. And the extent of current actions does not come close to matching the magnitude of the challenge. As a result, the climate battle, in the short term, has likely already been lost. Consumers throughout the developed world are unwilling to deprive themselves of some of the trappings of middle-class comfort. Without their support, and their willingness to pay for changes, companies enact only incremental initiatives rather than fundamental changes that can “move the needle.” Governments also cannot take substantive action because their citizens will vote them down or take to the streets in protest.

On top of all this, almost half of humanity lives on less than $5.50 a day. For them sustainability is an unaffordable luxury. And when they do industrialize and move into the middle class, emissions will increase even faster. Given the amount of carbon already in the atmosphere and its continued increase, the only solution is technology. While current efforts may slow down the increase in emissions, they are unlikely to reverse the trend in time. Long term respite is likely only if corporations and governments will turn away from “sustainability theater” and focus their efforts and investments on research into carbon sequestration and removal technologies. Such technologies have the potential to actually reverse climate change.

The Case for Climate Optimism: A Response.

Kieren Mayers, Sustainable Operations Initiative (SOI), INSEAD; Jonathan G. Koomey, Researcher, Author, Lecturer, and Entrepreneur

“Climate Change: The Real Inconvenient Truth,” by Yossi Sheffi, suggests that current efforts to halt climate change will fail. It claims they are too expensive, undermined by misguided environmentalists, and beset by industry inaction. Sheffi argues that longer-term investment in carbon capture and storage is the only viable solution. We argue that a range of measures enacted over this decade can address climate change. These include renewable power, electrification, energy efficiency, phasing out coal, forestation, and soil management. While these approaches require substantial international investment and political action, they are unlikely to cause the dire economic circumstances often envisioned. Inaction certainly will.

The falling cost of renewables is upending energy markets, making renewable power competitive with coal and nuclear. In contrast, relying solely on long-term carbon capture and storage, particularly directly from the air, is an unaffordable gamble, rigged to fail at the first hurdle. It would consume an infeasible proportion of the world’s economic and electrical output and miss critical 2030 emissions targets.

With sufficient political will, we can address climate change. The UK’s coal phase-out and adoption of renewables, and the renewable energy use and reforestation in Costa Rica are substantive successes. Pessimism should not blind us to our progress or to our opportunities to address climate change now.

Service Industrialization, Convergence, and Digital Transformation – I.

Uday Karmarkar, UCLA Anderson School of Management

Information-intensive services already dominate the US and other developed economies in GNP and wage bill share. Economies around the world are following this trend at differing rates as technological industrialization drives massive changes, not only for economies and industry, but also for firms, work processes, and jobs. The consequences of this transformation present a mixed picture for economies, companies, and individuals. While average wealth in the US continues to increase, employment is declining in many job categories, accompanied by losses in wage share. Technology has created fundamental changes in the economics of service processes, enabling their industrialization and thereby...
altering industry structure. As a result, previously distinct service sectors have begun to converge in ways that are driving significant structural changes, including vertical de-integration, horizontal dominance by specific technologies, the outsourcing of noncritical processes, third party provision of web services, the emergence of platform strategies, and a rapid growth of lateral bundling. These dramatic changes have already severely disrupted many service sectors, leaving others on the edge. Managers and policy makers need to respond swiftly to such changes which are likely to continue to occur for several decades. Delays could prove very costly.

Navigating Digital Turbulence.


When digital turbulence becomes normal, vigilant organizations win by following three navigation principles. First, their leaders focus on detecting and understanding early warning signals. Second, they adjust their perception of urgency and timing so they are poised to act swiftly and decisively when the time comes. Third, they ensure that each level of the organization is capable of sensing change, seizing the moment, and transforming itself, bringing agility to the whole. We use Adobe, Ford, and Mastercard as instructive examples of how leaders can spot and act on new possibilities amidst digital turbulence. Firms which do not follow these principles lose their strategic freedom and become vulnerable to attack because their only remaining option is to react to passing events. Knowing how to navigate digital quakes, which can strike suddenly and without respect for market boundaries, requires agility, urgency, and clarity of thought in the face of the complexity and uncertainty that new business models or ecosystems create. Digital turbulence can be either a bane or boon, depending on how leaders shape organizational mindsets, structures, processes, and culture.

What Evolutionary Biology Can Teach Us About Corporate Reputation.

Paul A. Argenti, The Tuck School of Business, Dartmouth College; Ryan Calsbeek, Department of Biological Sciences, Dartmouth College

Since the advent of the *Fortune* Most Admired list in the early 1980s, major corporations have been obsessed with rankings. We suggest that they should instead focus on the attributes that influence those rankings. By combining evolutionary biology, the study of traits that make great competitors, with corporate reputation research, focusing on contributing attributes rather than external ratings, we have developed a new, interdisciplinary approach to measurement. Through this approach, corporations can better understand which attributes differentiate great companies from their competitors in various contexts. We have tested it with major corporations, hoping to determine how to influence rankings and refine communication strategies. We believe it is time for companies to use scientific methods to measure and nurture their reputations, rather than social science approaches rooted in gut instinct. The ability to adapt to the changing needs of constituents in the 21st century depends upon it.

Leonard Kleinrock, Internet Pioneer.

Dr. Morten Bay, USC Annenberg School of Communication

The Internet is a technological movement borne out of collaborations between thousands, or perhaps millions, of contributors. But it began with a small group of people who had a vision and took on the intense labor of realizing it. One of those essential figures in the history of the Internet is Leonard Kleinrock. Kleinrock was instrumental in the development of technologies that underpin most networked data transmissions today, including the Internet. In 1967, the Defense Advanced Research Project Agency, or DARPA (then ARPA) tasked Lawrence Roberts with planning and managing the construction of ARPANET, the world’s first network of heterogeneous computers. Roberts brought Kleinrock on board and ARPANET was launched on October 12, 1969. It was a remarkable success, spawning multiple imitation networks that eventually merged into what we now know as the Internet. In 1988, Leonard Kleinrock chaired the National Research Council committee that produced the report upon which then-Senator Al Gore would base his 1991 High Performance Computing Act, legislation which dramatically improved and upgraded the computer network infrastructure across the U.S. and paved the way for the Internet’s eventual ubiquity.

George Bernard Dantzig: The Pioneer of Linear Optimization.

John R. Birge, University of Chicago Booth School of Business

George Dantzig introduced the world to the power of optimization, creating trillions of dollars of value and saving countless years of life across the globe. Linear programs and Dantzig’s many other contributions to optimization have driven enormous increases in productivity throughout the global economy. Linear programming has also become a vital tool in advancing artificial
intelligence and machine learning, and it is used in electrical stimulation therapy, chemotherapy plans, drug discovery, radiation therapy designs, and finding optimal diets. Linear programming and its various extensions continue to play an influential role in the economy and in all our lives.

**Enterprise Adoption and Management of Artificial Intelligence.**

**Thomas H. Davenport**, Babson College

Roughly a quarter to a third of large businesses are now adopting artificial intelligence (AI), particularly in data-intensive industries. AI is supported by key technologies with a range of applications, and it is being put to a variety of uses. Nonetheless, in order for firms to transform to AI from less advanced systems, they must approach it with an appropriate level of ambition. AI tends to be applied to innovation and efficiency-oriented objectives, though this may change with economic conditions. AI is affecting both jobs and marketable skills already and will probably have a greater impact in the future. Currently, there are four main trends which seem likely to substantially influence the future use of AI in enterprise.

**The New AAA Supply Chain.**

**Hau L. Lee**, Graduate School of Business, Stanford University

Supply chains need to be agile, adaptive, and aligned. In today’s business environment, with increasing uncertainties in both demand and supply, we need something more than standard agility. Super-agility demands sensing that is smart and very fast, and a response that is equally fast. To achieve super-agility we must apply advances in digital technologies, along with all the principles of supply chain management such as postponement, advanced analytics, and flexible manufacturing. Geopolitical changes in global trade, as well as disruptions caused by either natural or man-made disasters, also demand the adaptation of supply chain design. This process requires the dynamic adaptation of sourcing strategies, investment in technology, agile operational capabilities, and end-to-end configuration of value chains. With an ever-increasing number of stakeholders influencing how effective a supply chain is, companies need to align the interests and incentives of their broader ecosystem, including non-market elements such as NGOs, industry consortiums, governments, companies in related supply chains, and global communities.

**Digital Operations: Autonomous Automation and the Smart Execution of Work.**

**Robert N. Boute**, KU Leuven and Vlerick Business School; **Jan A. Van Mieghem**, Kellogg School of Management, Northwestern University

In digital operations, firms use a data IT platform to digitally support their workflow. By linking the platform to the Internet, they enable web-based applications, remote assistance, and real-time connections with physical devices (Internet of Things) and mobile/ wearables (Internet of People). Like airport control towers, digital operations permit firms to monitor and visualize the flow of work in real time. A digital foundation allows companies to use advanced algorithms, and perhaps artificial intelligence, for real time analysis and optimization. By digitizing operations they can augment human work with smarter workflows or replace it with increased automation. We present a framework that disentangles the implications of automation and autonomy from those of smart control and artificial intelligence.

By evaluating the levels and reach of digitization, automation, and smart control throughout the value chain, we offer a diagnostic tool that can guide future digitization. Finding your optimal level of digitization requires a careful cost-benefit analysis. In complex environments, the cost of autonomous automation often exceeds its benefit. We therefore believe that collaboration between human and machine will remain worthwhile. We caution against full automation in complex settings with high downside risk because such autonomous automation requires the highest level of smart control.

**The Cost of Capital. If Not the CAPM, Then What?**

**Ivo Welch**, UCLA Anderson Graduate School of Management

The capital asset pricing model (CAPM)—the workhorse model for determining the cost of capital—is simply wrong. In fact, the equity component is so badly wrong that it is better to ignore it altogether and instead to assign equal costs of capital to equities with different market-betas. The CAPM is still taught because it has taken on a life of its own. Students need to learn it only because most firms and valuation assessors use it, not because it has any empirical validity. However, this does not mean that projects should all be assigned the same cost of capital. There are many project and corollary characteristics that should be used to help assess differing costs of capital. For example, comparables, leverage ratios, market capitalization, project duration, liquidity, etc., should all be taken into account. Unfortunately, good cost of capital estimates no longer follow a simple, tidy theory. C’est la vie. I suggest an alternative, albeit
ad hoc, capital structure theory: firms could minimize the weighted cost of debt capital, effectively ignoring the cost of equity capital.

**Give Yourself a Nudge to Make Smarter Business Decisions.**

Ralph L. Keeney, Fuqua School of Business, Duke University

The foundation for quality decisions rests upon three elements: defining the decision, stating its objectives, and creating alternatives from which to choose. Research shows that many people make decisions without working through these steps, which leads them to make inferior decisions. Our innovative approach uses a range of concepts and techniques to help you create a sound foundation for your decisions. Defining the decision you should make constitutes a decision in itself. It helps to develop several decision statements and select the most appropriate one. To help you generate a complete set of objectives for your decision, we suggest several mind-stimulating techniques drawn from decision consulting experience and practical research. Use these objectives to create desirable alternatives, since any useful alternative must contribute to at least one objective. Then, combine initially suggested alternatives to create alternatives that contribute to all of your objectives. The full set of objectives will guide you to select the alternative which will best achieve them. As you work through the three foundational decision elements, you will better understand your decision, nudging yourself toward the ultimate business advantage: making smarter decisions.

**How Analytics Allowed the FCC to Save $7.3 Billion by Auctioning Underused Television Spectrum.**

Subodha Kumar, Temple University

In order to reallocate underutilized portions of the television spectrum to the wireless industry, the US Federal Communications Commission (FCC) innovatively used modern analytical tools to design and enact the world’s first two-sided incentive auction. This auction not only allowed the FCC to save $7.3 billion, but also helped to meet the growing US demand for wireless data and created jobs throughout the country. This use of analytical tools has lasting implications and lessons for managers and policymakers, not only in telecommunications, but also in related industries. It constitutes an exceptionally efficient means of matching supply against demand. Other industries, such as healthcare and hospitality, face similar apparent mismatches and might profitably employ a similar process.
MBR ANNOUNCEMENTS
Join 830,457 Subscribers and Become an MBR Charter Subscriber to Receive a Price Discount for Life

When you subscribe for 2021 or 2022 at the low introductory price, you will become a charter subscriber, which will entitle you for life to a discount on the list subscription price. Furthermore, while other journals charge additional fees for classroom use of articles, MBR will make its articles freely available for use in degree program classes at any school whose library subscribes to MBR.

Subscribe online at: https://mbrjournal.com/join-mbr/

<table>
<thead>
<tr>
<th>Subscription Prices</th>
<th>Four Issues Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2021</td>
</tr>
<tr>
<td><strong>Individual</strong></td>
<td></td>
</tr>
<tr>
<td>Digital</td>
<td>$10*</td>
</tr>
<tr>
<td>Both</td>
<td>$40</td>
</tr>
<tr>
<td><strong>Libraries: Colleges and universities</strong></td>
<td></td>
</tr>
<tr>
<td>Digital</td>
<td>$300</td>
</tr>
<tr>
<td>Both</td>
<td>$360</td>
</tr>
<tr>
<td><strong>Libraries: Community colleges, colleges with a budget of less than $1 million, nonprofit organizations, and government departments</strong></td>
<td></td>
</tr>
<tr>
<td>Digital</td>
<td>$200</td>
</tr>
<tr>
<td>Both</td>
<td>$260</td>
</tr>
<tr>
<td><strong>Libraries: K-12 schools</strong></td>
<td></td>
</tr>
<tr>
<td>Digital</td>
<td>Complimentary</td>
</tr>
<tr>
<td>Both</td>
<td>$60</td>
</tr>
</tbody>
</table>

*Digital copies of the first two issues are complimentary
Each annual volume of the Management and Business Review (MBR) will include over 50 articles on timely and important issues in business and management. Reading these articles is a highly effective way for your employees to keep up to date on the latest ideas in management thought from leading business scholars and leaders. You can try out MBR in 2021 or 2022 at a low introductory price. If you do, you will also become a charter subscriber, which will entitle you for life to a discount on the list subscription price.

### Per Person Subscription Price

<table>
<thead>
<tr>
<th>Digital or Both Digital &amp; Print</th>
<th>2021</th>
<th>2022</th>
<th>2023 Charter Subscribers</th>
<th>2023 List price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital</td>
<td>$5*</td>
<td>$10</td>
<td>$15</td>
<td>$20</td>
</tr>
<tr>
<td>Both</td>
<td>$30</td>
<td>$30</td>
<td>$40</td>
<td>$60</td>
</tr>
<tr>
<td>Digital</td>
<td>$0.50*</td>
<td>$1</td>
<td>$2</td>
<td>$2</td>
</tr>
<tr>
<td>Both</td>
<td>$30</td>
<td>$30</td>
<td>$40</td>
<td>$60</td>
</tr>
</tbody>
</table>

*Digital copies of the first two issues are complimentary

### Customize MBR to Serve Your Constituents and Elevate Your Brand

You can customize MBR by adding special content tailored for your company’s mission and the needs of your employees, customers, and suppliers. This customization will strengthen your relationship with your constituents and elevate your company’s brand. Companies that choose to customize MBR will be listed on our masthead as Partner Companies. For bulk subscriptions and customization, please contact Publisher and Coeditor in Chief Kalyan Singhal at <Ksinghal@ubalt.edu>.

### Share the First Two 2021 Free Issues with Your Constituents and MBR Will Customize Their Covers for You

We encourage you to share complimentary digital copies of this issue and the next with your employees, customers, friends, and suppliers. We will customize the covers of these two digital issues free of charge. Please write to <mbr.prod@cenveo.com> with the email subject: "Customizing Covers; Code Two" and describe your custom message, for example, “With Compliments of Jennifer Hall, Macro Pickard Corporation.”
We invite the deans of business schools to customize MBR with content specific to their schools. By customizing, you can insert content tailored to your school’s mission and the needs of your stakeholders, including business school and non-business alums of your university, employees of your industry affiliates, and your faculty and students.

This customization will benefit your stakeholders and elevate your school’s brand. For 2021 and 2022, MBR is also offering special pricing on custom options. Schools that choose to customize MBR will be listed as Partner Schools on MBR’s masthead. Please contact Coeditor in Chief Kalyan Singhal at <Ksinghal@ubalt.edu> to discuss pricing and customization options.

With our special pricing, you will also be able to share complimentary digital copies of your customized MBR with your business school alums and also with alums from your university’s other disciplines, acknowledging that students from a diversity of disciplines and majors ultimately go into business. Your alums will also have the opportunity to subscribe to the print version of your customized MBR. Likewise, the managers of your industry affiliates will be able to subscribe to its digital and print versions.

For 2021 and 2022, we encourage you to order MBR for your library at the special price of $300 per year. Unlike some journals, which charge for classroom use, MBR will make its articles freely available for use in degree program classes at any school whose library subscribes to MBR.

We encourage you to share complimentary digital copies of this issue and the next with your constituents. We will be happy to customize the covers of these two digital issues free of charge. For customization, please write to <mbr.prod@cenveo.com> with the email subject: "Customizing Covers; Code one” and describe your custom message, for example, “With Compliments of Dean Andrea Fisher, Roth School of Management.”
Share the First Two Issues of MBR with Everyone You Know and Encourage Them to Share with Everyone They Know

The Management and Business Review is meant for everyone in the business community around the world. To get it into the hands of as many people as possible, we request that you share this issue and the next with everyone you know. This issue is available at the link below, as the next issue will be once it is published.

https://mbrjournal.com/2021-2-free-issues/

You can pass along these issues in several ways:

1. Share each issue or the above link by email with everyone you know who might be interested. You might also want to share it with everyone in your Send folder or any other folder. Please remember to invite your recipients to share it with their contacts and so on. Here are two links to download instructions for sending emails from your folder:


   It may be a good idea if you put yourself in the “To” field and your contacts in the “Bcc” field. That way, you will avoid sharing everybody’s email with everybody else on the list.

2. Post the issue or the above link publicly on your website or on social media and invite your contacts to do the same, creating a distribution chain.

3. Invite the head of your organization to share the issue or the above link throughout your organization.

   Thank you for helping us to spread the word about MBR and strengthen our global business community.
Join MBR on Social Media

We invite you to join us on social media for the latest updates on Management and Business Review (MBR). We will use our social media to give you the latest updates on what is happening with the journal and also as a space in which academic and industry readers can engage with one another. We hope these platforms will become a nexus of rich and rewarding discourse about business and management for the expansive community of business students, scholars, and practitioners.

We therefore encourage you to make use of the social media resources we have created for you.

**Facebook:** Follow us at @MBRJournal or https://www.facebook.com/MBRJournal.

**Twitter:** Follow us at @MBRJournal or https://twitter.com/MBRJournal.

**LinkedIn:** Follow us at https://www.linkedin.com/company/management-and-business-review-mbr-journal.

Please use #MBRJournal and tag us @MBRJournal on LinkedIn, Facebook, and Twitter. We also invite you to use these platforms to highlight your own MBR papers.

For suggestions and questions related to @MBRJournal social media pages, please contact Professor Subodha Kumar, Executive Editor, Management and Business Review at subodha@temple.edu.
Awards for Research That Has Benefited Organizations and Society

Instituted by the Management and Business Review

In support of the broader mission of the *Management and Business Review* (MBR), we are creating twenty-five biennial awards which recognize research that has benefited business and society during the last 50 years. These awards cover most of the topics central to the role of management in the private and public sectors and to addressing the key challenges of our times. We have named these awards after scholars, educators, administrators, and executives whose work has made organizations and society more productive, the work environment more rewarding and fulfilling, and human lives longer and healthier.

1. The Mary E. Barth (Stanford University) and Christopher Ittner (University of Pennsylvania) Award for Research in Accounting
2. The K.P.K. Nair (University of New Brunswick) and Gang Yu (111, Inc.) Award for Research on Africa, Asia, and Latin America
3. The Herbert A. Simon (Nobel Laureate, Carnegie Mellon University) Award for Research in Artificial Intelligence
4. The Cynthia Barnhart (MIT) and Tom Davenport (Babson College) Award for Research in Business Analytics
5. The Subodha Kumar (Temple University) and Geoffrey G. Parker (Dartmouth College) Award for Research on Digital Transformation
6. The Kenneth Arrow (Nobel Laureate, Stanford University) Award for Research in Economics
7. The Melanie Hopp Award for Innovations in Management and Business Education
8. The Raj Gupta (formerly of Rohm and Haas) and Erika James (University of Pennsylvania) Award for Publications for Executives, Managers, and Professionals
9. The Teck-Hua Ho (National University of Singapore) and N. R. Kamath (Indian Institute of Technology, Bombay) Award for Research in Engineering and Technology
10. The L. Beril Toktay (Georgia Institute of Technology) and Luk Van Wassenhove (INSEAD) Award for Organizational Research into the Environment and Sustainability
11. The Harry Markowitz (Nobel Laureate, University of California, San Diego) Award for Research in Finance
12. The Arie Lewin (Duke University) and Ananth Raman (Harvard University) Award for Research in International Business

13. The Linda V. Green (Columbia University) and Sridhar R. Tayur (Carnegie Mellon University) Award for Research in Healthcare Management

14. The Charles Fine (MIT) and Dipak C. Jain (China Europe International Business School) Award for Research on Innovation

15. The John R. Birge (University of Chicago) and Pinar Keskinocak (Georgia Institute of Technology) Award for Interdisciplinary Research

16. The Stephen C. Graves (MIT) and Mark L. Spearman (Strategic Project Solutions) Award for Research in Manufacturing

17. The Philip Kotler (Northwestern University) and Yoram (Jerry) Wind (University of Pennsylvania) Award for Research in Marketing

18. The Linda Argote (Carnegie Mellon University) and Henry Mintzberg (McGill University) Award for Research in Organization Science

19. The Murray Dalziel (University of Baltimore) and Christoph Loch (Cambridge University) Award for Research on Project Management and Strategic Change

20. The Alfred Blumstein (Carnegie Mellon University) and Ramayya Krishnan (Carnegie Mellon University) Award for Research in Public Administration

21. The Charles Corbett (UCLA) and Sunder Kekre (Carnegie Mellon University) Award for Research that Unites Theory and Practice

22. The Howard Kunreuther (University of Pennsylvania) and Paul Slovic (University of Oregon) Award for Research in Risk Management

23. The Uday Karmarkar (UCLA) and Costis Maglaras (Columbia Business School) Award for Research on Services.

24. The Vijay Govindarajan (Dartmouth College) and Gary Hamel (London Business School) Award for Research on Strategy and Corporate Governance

25. The Morris A. Cohen (University of Pennsylvania) and David Simchi-Levi (MIT) Award for Research on Supply Chain Management
Because the articles in the Management and Business Review deal with pressing issues and leading-edge research, they will be of great interest to all students in management and business. These articles also constitute a major resource for teaching in management and are therefore natural supplements to business textbooks.

Unlike some journals, which charge additional fees for classroom use, MBR will make its articles freely available for use in degree program classes at any school whose library subscribes to MBR. It may, however, take a little time for MBR to become available in all business school libraries.

We are therefore offering options for textbook publishers to make MBR available as a supplement to students using their books. Publishers may choose a rate of either two cents per student per semester for all students using books in management and business or one dollar per student per semester for only those students at universities without library access to MBR. Textbook publishers may want to begin with the former option and then switch to the latter when more libraries have subscribed to MBR.

Please contact Coeditor in Chief Kalyan Singhal at <Ksinghal@ubalt.edu>
As part of an ongoing effort to track the responses of businesses to the pandemic, The Conference Board polled over 1,100 business people in twenty statistical metropolitan areas about their reopening practices. A summary of the results is available at https://www.conference-board.org/press/Reopen_Workplace_Survey_Sept2020. One notable highlight of these results was that only about 60% of businesses surveyed how ready and comfortable their workers felt about returning to work. Companies that did survey their employees were more likely to enact safeguards than those that did not.

Differences Between Companies That Surveyed Their Employees and Those That Didn’t

- **Implemented safety measures** and/or policies specifically for workers taking public transportation: 41%
- **Revised work-from-home policies** to allow more employee choice of returning to the workplace: 35%
- **Provided childcare options** for workers: 35%
- **Opened additional communication channels** to address health and safety concerns for workers returning to an office or work site: 32%
- **Implemented additional safety measures** for at-risk populations: 32%
- **Created staggered timing** for business units or workers to reenter the workplace: 31%
- **Redesigned the work environment** to minimize worker contact: 28%
- **Planned for staggered shifts** within the workday or work week to reduce worker contact: 27%
- **Prepared work space** for return of workers: 26%
- **Changed policies related to sick leave** or implemented new policies for workers who have contracted COVID-19: 26%
- **Created new workplace policies** requiring social distancing: 25%
- **Created procedures for reducing** contact with visitors or customers: 25%
- **Required screening, testing or temperature checks** for returning workers: 23%
- **Purchased safety equipment**: 23%

Note: This chart shows the difference between respondents whose organizations “surveyed workers about levels of readiness and comfort in returning to the workplace” and those that did not survey workers.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kihyun Hannah Kim and V. Kumar.</td>
<td>Money or Friendship? Winning Over Customers</td>
</tr>
<tr>
<td>Andrew Campbell, Mikel Gutierrez.</td>
<td>Why You Need an Operating Model: To Align Your People and Deliver Your Strategy</td>
</tr>
<tr>
<td>Uday Karmarkar.</td>
<td>Service Industrialization, Convergence, and Digital Transformation – II</td>
</tr>
<tr>
<td>Jan-Benedict E.M. Steenkamp.</td>
<td>Admiral Jacky Fisher and the Art of Disruptive Leadership</td>
</tr>
<tr>
<td>Sunil Mithas, Roland T. Rust.</td>
<td>Pursue Both Revenue Growth and Cost Reduction with Digital Transformation</td>
</tr>
<tr>
<td>Arvind Malhotra, Ann Majchrzak, Alpheus Bingham.</td>
<td>A Future of Work and Organizations</td>
</tr>
<tr>
<td>Paul J. H. Schoemaker.</td>
<td>Forget Dumb Luck - Try Smart Luck: Strategies to Get Lady Fortune on Your Side</td>
</tr>
<tr>
<td>Lennart Baardman, Maxime C. Cohen, Kiran Panchamgam, Georgia Perakis.</td>
<td>Upgrading Promotions Using Business Analytics</td>
</tr>
<tr>
<td>David De Cremer.</td>
<td>Can Blockchain Manage Trust in Organizations?</td>
</tr>
<tr>
<td>Maxime C. Cohen, Samuel Dahan, Colin Rule.</td>
<td>Conflict Analytics: When Data Science Meets Dispute Resolution</td>
</tr>
<tr>
<td>V. Kumar, Ashutosh Dixit, Rajshekhar ‘Raj’ G. Javalgi, Nazli Z. Turken.</td>
<td>Can Artificial Intelligence Overshadow Human Intelligence? Serendipitous Connections, Persistence of Interest, and Impact on the Bottom Line</td>
</tr>
<tr>
<td>Sunil Chopra.</td>
<td>Designing Omni-Channel Retailing to Align Strategy and Financial Performance</td>
</tr>
<tr>
<td>Qing Li, Christopher Tang.</td>
<td>Unlocking the Value of Innovative Selling: Information and Options</td>
</tr>
<tr>
<td>Charles J. Corbett, Uday S. Karmarkar,</td>
<td>The Internet at Fifty: The Pioneers, Engineers, and Influencers of its Past and Future</td>
</tr>
<tr>
<td>Christopher S. Tang.</td>
<td>You Move Me: Understanding and Optimizing Job Rotation</td>
</tr>
<tr>
<td>Anatoli Colicev, Ashwin Malshe, Koen Pauwels.</td>
<td>How Brands Can Leverage Their Social Media Marketing</td>
</tr>
<tr>
<td>Stefan Wuorinen, Brian A. Burgess, Patrick M. Wright.</td>
<td>Managing Mergers and Acquisitions: Perspectives from Human Resources</td>
</tr>
<tr>
<td>Teppo Felin, Alfonso Gambardella, Todd Zenger.</td>
<td>Value Lab: A Tool for Entrepreneurial Strategy</td>
</tr>
<tr>
<td>Wallace Hopp, Jun Li, Soroush Saghafian, Guihua Wang.</td>
<td>Analytics-Powered Employee Health Plans</td>
</tr>
</tbody>
</table>