MIT Sloan

Faculty research briefs from Professors Catherine E. Tucker, Andrew W. Lo, and Fiona E. Murray

The Startup Files: Entrepreneurship at MIT Sloan

POSITIVE FUTURES
Harnessing the potential of the digital economy
News and insights for alumni
Vol. 7, No. 1

DEAN
David Schmittlein
John C Head III Dean

ASSOCIATE DEAN, EXTERNAL RELATIONS
Kristina Gulick Schaefer

MANAGING EDITORS
Catherine Canney
Kristin LeClair

PRODUCTION EDITOR
Jennifer Montfort

COPY EDITOR
Jennifer Liddiard

CONCEPT AND DESIGN
Robert Beerman, Onward Upward

CONTRIBUTORS
Grace Benson, Michelle Choate, Zach Church, Stuart Darsch, Mikhail Glabets, L. Barry Hetherington, Mark Keene, Justin Knight, Rebecca Knight, Peg Skorpinski

PROOFREADER
Linda Walsh

PRINTING
Lane Press

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Change of address
MIT Sloan Office of External Relations
77 Massachusetts Avenue, E60-200
Cambridge, MA 02139
Email: editor@sloan.mit.edu

Contacts
For subscription information, permissions, and letters to the editor, contact our editorial staff.
Phone: 617-253-7164
Email: editor@sloan.mit.edu

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The Startup Files: Entrepreneurship at MIT Sloan

MIT Sloan is at the forefront of the new age of entrepreneurship. In this section, we explore the opportunities and challenges experienced by four student-created ventures—Bounce Imaging, Wecyclers, lark technologies, and peerTransfer Corporation—in their own words.

The Takeaways: MIT Sloan Faculty Members Offer Their Perspectives

MIT Sloan’s faculty members are contributing to discussions on the world’s most pressing issues. We’ve gathered excerpts from various media sources to provide insights into the questions our faculty answer every day.

Innovation at Work

MIT Professors Share Excerpts from Their Recent Research

Catherine E. Tucker: Can Healthcare IT Save Babies?

Andrew W. Lo: Can Financial Engineering Cure Cancer?

Fiona E. Murray: Eyes on the Grand Innovation Prize

Feature Story

Positive Futures

A future where machines take the place of humans is a disconcerting idea for many. But where there is concern, there is also the possibility to harness the unlimited potential of the digital economy—at least according to Professor Erik Brynjolfsson and Principal Research Scientist Andrew McAfee.

Departments

Message to our alumni
Letter from the dean
In the world

On the cover: Schussel Family Professor of Management Science, Erik Brynjolfsson and Principal Research Scientist Andrew McAfee believe the key to harnessing the big data revolution is the development of organizations and institutions tailored to the new digital age. To find out why, see the article “Positive Futures” on page 24.
Updates on Innovation & Invention

DEAR ALUMNI,

We are delighted to share a special issue of the MIT Sloan Alumni Magazine with you; one that is devoted to invention and the entrepreneurial spirit. This is a magazine that reflects the significant work being done by our faculty to drive innovations in management practice across multiple industries and professions.

You will notice some differences in this issue—for example, three faculty research briefs, rather than the usual one. Why this change? Because what you tell us, and our colleagues on the road, is that you want more knowledge. You want access to the groundbreaking research being done by MIT Sloan faculty, and you want to hear about the new ventures being started by our students. You are profoundly interested in the Initiative on the Digital Economy as exhibited by the fact that more than 500 of you attended conferences in Cambridge and San Francisco this year to learn more. You also want to see MIT Sloan’s global presence expand (take a look at the map on pages 14–15).

We hope that this special issue of MIT Sloan provides a window into all these things and that you will let us know what else you want to hear about. This is your magazine, and an opportunity for us, as a School, to share with you what is happening on campus and beyond. To share feedback and ideas, please email us: editor@mitsloan.mit.edu.

In the meantime, we hope that you enjoy learning about the innovative work being done at MIT Sloan and that you find it as exciting and interesting as we do.

Catherine Canney
Executive Director, Brand Strategy; Special Assistant to the Dean

Kristin LeClair
Director, Donor Relations and Communications
Dear alumni and friends of MIT Sloan,

The MIT Sloan School of Management is distinctive and distinguished by its association with the greater MIT community. Simply put, there is no better place for solving the world’s greatest challenges than MIT. We are the place for innovation; the place for invention; the place for improving the world. Those of us who are part of this community have an incredible opportunity and feel an important responsibility to bring knowledge to bear on the issues and opportunities that face our country and our world.

A very particular type of person is drawn to MIT Sloan. Our faculty do not always say what is popular, but rather are committed to saying the things that matter; the things the world needs to know. Our students are not driven solely by personal interest or promotion, but instead exhibit a commitment to finding solutions for the betterment of humanity. This community never rests on initial discovery—always on our collective horizon is the next innovation, the next invention, and the tireless drive to improve.

This special edition of MIT Sloan provides a window into that leadership. “The Startup Files” (page 4) gives voice to the innovative, entrepreneurial spirit of our students, and shares how they maximize MIT resources to bring exciting new ventures into the world. Research briefs from Professors Catherine E. Tucker, Andrew W. Lo, and Fiona E. Murray highlight the breadth and depth of MIT Sloan’s thought leadership, as well as our faculty members’ commitment to providing relevant, timely insights that drive positive change. Our feature article on the work of Professor Erik Brynjolfsson and Principal Research Scientist Andrew McAfee exemplifies a hallmark of research at MIT Sloan—a firm and true commitment to predicting and preparing for transformative changes in business and society.

As the dean of the School, I am inspired daily through interactions with our faculty and students. It is my firm hope that this special issue and future issues of MIT Sloan will bring some of that inspiration to you, our alumni. You are part of the story that is MIT Sloan. Please accept my gratitude for all you do for the School, the Institute, and the world.

Best regards,

David Schmittlein
John C Head III Dean
**THE STARTUP FILES:**  
**ENTREPRENEURSHIP AT MIT SLOAN**

<table>
<thead>
<tr>
<th>COMPANY NAME</th>
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<td>Bounce Imaging</td>
<td>March 2012</td>
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<th>TEAM MEMBERS</th>
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| Francisco Aguilar  
MIT Sloan School of Management, MBA 2012  
Harvard Kennedy School, MPP 2012 |
| David Young  
MIT Sloan School of Management, MBA 2013 |

**THE PITCH**

At Bounce Imaging, we’re developing low-cost, throwable imaging and sensor platforms that enable police officers, soldiers, firefighters, and other first responders to see inside dangerous, unseen spaces without exposing themselves to harm.

**THE IMPACT**

Our mission is to make lifesaving imaging technology accessible to those who need it most. Current imaging/sensor solutions (like robots or drones) are too costly and too complex for broad deployment. In a world of new and evolving threats, police officers and other first responders now need access to this type of technology to protect themselves from harm. At our low target price point ($500 – $1,000 to start), the technology will one day be accessible to first responders not only in the United States, but also in the developing world.

**THE RESOURCES**

MIT Sloan offered relevant courses in entrepreneurship, space for meetings and calls, and a network that helped us connect to customers and advisors in law enforcement, the military, and other sectors. The MIT Venture Mentor Service also has been immensely helpful.

MIT has long been recognized as an incubator for would-be entrepreneurs, and the Martin Trust Center for MIT Entrepreneurship harnesses the best that MIT has to offer. Each of these ventures had a unique beginning—an idea hatching, a pitch to investors and clients, an experience that created an organization. Here, in their own words, students and recent graduates explain the challenges and opportunities they’ve experienced along the way in starting their new ventures. 

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A list of the companies started by 2012 graduates welcomes visitors to the Trust Center. As of March 2013, there are 76 new ventures and counting.
The Pitch

Wecyclers is focused on solving the urban waste challenges that plague low-income neighborhoods in the developing world. We empower poor communities to clean up their neighborhoods—leading to healthier, more attractive environments. We collect recyclable material for free from households using cargo bicycles and we motivate people to participate through a rewards program. We then sell the material collected to recycling processors, and provide consumer brands with opportunities to sponsor rewards.

The Impact

Wecyclers makes a difference by creating a way for community members to safely and conveniently recycle plastic and aluminum waste. If not recycled, this waste would have ended up on the street or in landfills. By reducing urban waste, we impact the health and sanitation of the local environment while also contributing to reduced CO2 emissions by providing more recycled content to industrial processors. We also are providing stable jobs to young people in countries such as Nigeria, which has a national unemployment rate of 20 percent.

The Resources

MIT Sloan helped us in every way possible! We launched the idea in Joost Bonsen’s Development Ventures class, we participated in the Global IDEAS Challenge and the MIT $100K Entrepreneurship Competition, we joined the MIT Venture Mentor Service, and we participated in the Trust Center’s inaugural Founder Skills’ Accelerator program. Without the feedback, encouragement, mentorship, and seed funding we received, Wecyclers would not be here today.

We asked each venture to provide us with words that best described their experience in creating a startup. Here, and in the following pages, are their responses.
The Pitch

Founded in 2010, lark technologies is a consumer electronics company that makes wearable wellness monitors. Our products include larklife, lark, and lark pro. We take a holistic approach to developing our products, which includes innovative hardware, intuitive software, and expert-backed content. lark is a venture-backed company funded by Asset Management Ventures, Golden Seeds, CrunchFund, and others.

The Resources

MIT Sloan’s offering of technology, business, and design courses enabled lark to take form. We relied upon a combination of resources to take lark from an idea to a successful company. We bootstrapped early on from the winnings of the MIT $100K Competition, received helpful advice and guidance from mentors, and took classes that helped us write a business plan, price our products, and leverage data analytics.

The Impact

Whether your goal is more quality time with the kids or just having enough energy for a big night out on the town, our products help you celebrate the little daily victories in sleep, diet, and activity that lead to big results in how you feel. lark products work with you and your busy schedule. From reminding you to take breaks to coaching you to better sleep, larklife, lark pro, and lark help you get that extra energy to make the most of every day.
peerTransfer Corporation is a leading developer of innovative global payment solutions, initially focused on the education industry. The company enables thousands of international students and hundreds of schools to save time and money when making or receiving international payments. Compared to using traditional banks, students save on fees, enjoy a more convenient online experience, and receive superior customer service when making international payments. Schools benefit from peerTransfer’s solution by remaining compliant with ever-changing regulations and saving time and money by improving the processing of international payments.

We started with international tuition payments, helping hundreds of universities and schools and their thousands of international students from all over the world. We are growing at 20x the volumes moved per year, our team has tripled in the last year, and we are having an amazing experience. We want to make the world a better and less complex place for everyone.

Two of my classmates invested in the venture, I met my seed and Series A lead investor at an MIT $100K Competition event, and got many friendly classmates to help the startup via class projects. We leaned on, and are grateful to, the Trust Center for the support along the way.

We believe that international payments will be very different in the future, and we love that we are at the forefront of it. If you think about it, international wires haven’t changed in 40 years. When you make a payment, you still don’t know how much money and what information will show up on the other end (or when), and how much money the bank has taken as a cut. And there are trillions of dollars moved by individuals and small businesses that are suffering high banking fees, bad currency exchange rates, and an overall cumbersome and inefficient solution when sending or receiving money for needs as different as paying providers, purchasing goods, or receiving salary abroad. We want to improve the process.
Get involved, be inspired, stay connected!

**Like us on Facebook:** http://www.facebook.com/MITSloanAlumni

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**Get involved NOW in the Course XV Centennial Book!**

**MIT Sloan: Celebrating Our Past, Envisioning Our Future**

2014 marks the 100th anniversary of the founding of Course XV—the study of management at MIT. As one exciting contribution to the commemoration, we are publishing a beautifully illustrated book filled with reminiscences, stories, and essays from across the MIT Sloan community.

- 9.25” x 11” hardcover, c. 65,000 words
- 192 glossy full-color pages
- Up to 250 color and black and white images
- Publication February 2014

To send in your own memories, photographs, or memorabilia, please go to:
http://mitsloan.mit.edu/100years/
or write to us at centennialbook@mit.edu.

Be on the lookout for more details about centennial celebrations scheduled around the world!

Pre-order now for only $55* and save 25%

*PLUS shipping and handling

To pre-order your copy of the book and be listed as a book sponsor, go to [http://mitsloan.mit.edu/100years/](http://mitsloan.mit.edu/100years/)
Matt Marx and Bill Aulet on the United States’ loss of global talent...

"Innovation-driven entrepreneurs are the engine of a vibrant economy. Their high levels of education and their pursuit of global markets and rapid expansion create jobs and economic prosperity. And many of them, such as these MIT students, were not born in the United States."

Matthew Marx is the Alvin J. Siteman (1948) Career Development Professor of Entrepreneurship and William Aulet is a Senior Lecturer and the Managing Director of the Martin Trust Center for MIT Entrepreneurship

Caroline Flammer on business values...

"companies reported to behave responsibly towards the environment experience a significant stock price increase, whereas firms that behave irresponsibly face a significant stock price decrease. In general, she argues that corporate social responsibility ‘generates new and competitive resources for firms.’"

Caroline Flammer is a Lecturer in Global Economics and Management
Why digital maturity matters—“Digerati” drive true value from investments
George Westerman

Two years of study with more than 400 firms around the world shows how you can achieve a measurable digital advantage over your competitors.

This research, conducted by the MIT Sloan Center for Digital Business in cooperation with research sponsor Capgemini Consulting, shows that the digital advantage is not about luck or about the industry your firm is in. It is not just about how much cool digital stuff firms are doing. Companies that manage their digital activities in a certain way are 26 percent more profitable than their industry peers, and outperform on other measures as well.

In year one, we interviewed 157 senior executives in 50 large companies to understand how they are using social media, mobile, analytics, and embedded devices to change their businesses. We found that 70 percent were already using these technologies to change internal processes, customer engagement, or business models. But they are getting wildly different results.

The difference? Digital maturity. This year’s survey of nearly 400 firms shows that digitally mature companies do more than just invest in digital technologies. They also have the leadership skills—vision, governance, engagement, and IT/business relationships—to turn digital investment into digital transformation.

Digital maturity matters. It matters in every industry. And the approaches used by digitally mature companies are available to any company that has the leadership drive to do so.

MIT Sloan Experts Blog
George Westerman is an MIT Sloan Research Scientist

Yasheng Huang on China’s challenge...

“Chinese leaders want economic growth to come from innovations based on technology and science—a laudable goal. But it can’t be achieved by simply adding a massive dose of R&D spending to China’s current growth model. Technology-based growth requires protection for intellectual property, freedom to think and challenge authority, and a government with limited reach and power. In other words, it requires Western institutions.”

Yasheng Huang is the International Program Professor in Chinese Economy and Business

David McLean on making financial markets work better...

“Academics are interested in testing market efficiency, and predicting stock returns is one way to do that. The point of these papers is not to claim, ‘Hey, here’s this great way to make a lot of money.’ I think this research shows that markets want to be efficient, but there are costs and risks associated with getting there, so the market doesn’t end up in a perfectly efficient place.”

R. David McLean is a Visiting Associate Professor of Finance
The MIT Sloan faculty is increasingly sharing insights on and solutions to some of the most pressing business questions today. Their impact is clear; over the past five years, mentions of MIT Sloan in the media have doubled.

### MIT Sloan media visibility

<table>
<thead>
<tr>
<th>Year</th>
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<td>2007</td>
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<td>2012</td>
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**Fiona Murray and Bill Aulet on why all jobs are not created equal...**

“Small business creation is an important part of job creation, but it is only a part of what is needed to create large transformations in the economy. Innovation-driven companies—that start small but have the aspiration and potential to grow—will ultimately generate the new jobs and exports that economies need to drive prosperity.”

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**MIT Sloan Experts Blog**

Kristin Forbes is the Jerome and Dorothy Lemelson Professor of Management
What is the true cost of government-backed credit?
Deborah Lucas
November 13, 2012

The U.S. government is arguably the largest financial institution in the world. If you add the outstanding stock of government loans, loan guarantees, pension insurance, deposit insurance, and the guarantees made by federal entities such as Fannie Mae and Freddie Mac, you get to about $18 trillion of government-backed credit. Through those activities, the government has a first-order effect on the allocation of capital and risk in the economy.

The question of what those commitments cost the public is important; accurate cost assessments are necessary for informed decisions by policymakers, effective program management, and meaningful public oversight. My research and that of others has shown that if one takes a financial economics approach to answering that question—one that is consistent with the methods used by private financial institutions to evaluate such costs—it leads to significantly higher estimates than the approach currently used by the federal government.

At the core of the problem are the rules for government accounting, which by law require that costs for most federal credit programs be estimated using a government borrowing rate for discounting expected cash flows, regardless of the riskiness of those cash flows. That practice systematically understates the cost to the government because it neglects the full cost of risk to taxpayers, who are effectively equity holders in the government’s risky loans and guarantees.

An alternative approach to cost estimation—a fair value approach based on market prices—would fully take into account the cost of risk. Fully accounting for the cost of risk makes a significant difference: An estimate of the official budgetary cost of credit programs in 2013 shows them as generating savings for the government of $45 billion, whereas a fair value estimate suggests the programs will cost the government about $12 billion.

Finance Matters: The MIT Sloan Finance Group Blog
Deborah Lucas is the Sloan Distinguished Professor of Finance

Simon Johnson on the United States’ position in the world economy...

“So, while no country will rise up to take America’s place as the world’s leading economy, its global position is indeed threatened—by its own reluctance to have an honest conversation about the federal budget and by the unwillingness of its political leadership to confront powerful interests on Wall Street.”

“Will 2013 Mark the Beginning of American Decline?,” Bloomberg View, December 23, 2012
Simon Johnson is the Ronald A. Kurtz (1954) Professor of Entrepreneurship

Thomas Malone on creating more intelligent organizations...

“It’s also possible for groups of people to work together in ways that seem pretty stupid, and I think collective stupidity is just as possible as collective intelligence. Part of what I want to understand and part of what the people I’m working with want to understand is what are the conditions that lead to collective intelligence rather than collective stupidity.”

Thomas Malone is the Patrick J. McGovern (1959) Professor of Management and the Director of the MIT Center for Collective Intelligence
Financial System 2.0

The paradox of modern financial markets is that technology is both the problem and, ultimately, the solution. Today, the current financial system has reached a level of complexity that only highly trained experts with domain-specific knowledge are qualified to manage. The solution, of course, is not to reject financial technology, but rather to develop more advanced technology—a version 2.0 of the financial system. This event will highlight MIT’s vision for, and role in shaping, the Financial System 2.0. Please join us for a celebration of innovation in finance and technology, and to learn more about the Institute’s response to this challenge.

Finance for the Future

MIT is often referred to as “home to the pioneers of modern finance,” a place where many breakthroughs in financial economics were conceptualized. With traditions deeply rooted in finance, today’s faculty remains committed to ground-breaking research with a focus on the future. This event will feature talks by faculty on evolving financial markets and policy changes, and will bring a global perspective to the challenges facing the industry.

For more information, visit:
http://finance-group/scripts.mit.edu/financeforums/

To register, email: financeforums@mit.edu
Executive Education: Leading thinkers. Unique program content. Influential partners and participants.

MIT Sloan’s educational reach extends far beyond our traditional degree programs and nowhere more significantly than through our non-degree Executive Education programs. The wide array of courses brings together faculty from MIT and the MIT Sloan School of Management with leading practitioners. Attracting participants from every corner of the world (83 countries in 2012), MIT Sloan Executive Education classrooms provide a multitude of perspectives and experiences that together are positively influencing the way business is done around the world, while increasing MIT Sloan’s global visibility and impact. With courses that focus on everything from emerging technologies to entrepreneurship to sustainability, Executive Education programs, like all of MIT Sloan’s degree programs, are educating global citizens who will improve management practice and, ultimately, the world.

To learn more about upcoming Executive Education programs and opportunities, please visit: http://executive.mit.edu

**WHAT:** Understanding Global Markets: Macroeconomics for Executives (open enrollment program)

**WHERE:** Cambridge, MA

**FACULTY:** Roberto Rigobon

**THE PROGRAM:** By taking the mystery out of macroeconomics and international economics today, the program helps managers understand and predict the medium to long-run performance of economies in order to mitigate risk, develop growth plans, and make investment decisions locally and globally.

**WHAT:** Innovative Dynamics Education and Action for Sustainability (IDEAS) (custom program)

**WHERE:** Cambridge, China, and Indonesia

**FACULTY:** Dayna Cunningham, Yasheng Huang, Rick Locke, Otto Scharmer, Peter Senge, John Sterman

**THE PROGRAM:** In collaboration with United in Diversity, MIT Sloan offers IDEAS-Indonesia and IDEAS-China, leadership programs with the following motto: uniting leadership in diversity. The program brings together leaders from the private, government, and community (media, education, and NGOs) sectors to learn how to practice Theory U (Otto Scharmer) and the 5th Discipline (Peter Senge).
MIT SloanRegional Entrepreneurship Acceleration Program (REAP) (open enrollment program)

WHAT: MIT Regional Entrepreneurship Acceleration Program (REAP) (open enrollment program)
WHERE: China, Finland, Mexico, New Zealand, Scotland, Spain, and Turkey
FACULTY: Bill Aulet, Fiona Murray, Ed Roberts, Scott Stern
THE PROGRAM: REAP enables teams from across the globe to develop and implement custom strategies to transform their regional economies and propel their regions using innovation-driven entrepreneurship. This innovative two-year program promotes economic development and job creation through cross-functional team-based collaboration, cross-regional exchange, education, and a data-driven approach. Teams gather twice a year at MIT and around the globe to share their learnings and to be exposed to MIT faculty, leading-edge research, and the theory and practice of developing regional clusters of innovation-driven entrepreneurship.

Collaborating in Major Energy Projects (custom program)

WHAT: Collaborating in Major Energy Projects (custom program)
WHERE: Russia
FACULTY: Steve Eppinger, Roberto Fernandez, Don Lessard, John Van Maanen, Oli de Weck
THE PROGRAM: Now in its fourth year, this program is delivered in partnership with the SKOLKOVO School of Management in Moscow, with support from BP. It brings together executives from across the Russian oil & gas industry to study models and issues for collaboration and joint ventures in hydrocarbon exploration and production.

OCP MIT Management Academy (custom program)

WHAT: OCP MIT Management Academy (custom program)
WHERE: Cambridge and Morocco
FACULTY: Rick Locke, John Sterman
THE PROGRAM: OCP’s goal is to move into the global marketplace as a leading producer of phosphates and fertilizers. This Academy prepares OCP’s top executives by teaching leading management practice across functions and departments, with emphasis on globalization, sustainability, and operations and risk management.

*Statistics represent participation during the 2012 calendar year.
Can Healthcare IT Save Babies?
Catherine E. Tucker

Each year, more than 18,000 babies in this country die within their first 28 days of life. This grim statistic ranks the United States 43rd in the world in terms of neonatal mortality—tied with Montenegro, Slovakia, and the United Arab Emirates, and behind 24 of the 27 members of the European Union.

In addressing these and other disparities in U.S. healthcare, much policy emphasis has been placed on moving the country toward digital medical records and abandoning the current paper-based system. This effort culminated in 2009 with the Health Information Technology for Economic and Clinical Health (HITECH) Act, which promised large subsidies for healthcare providers who moved to digital records. However, there was little broad-scale evidence about the effectiveness of these investments.

To determine whether the United States would see a marked improvement in neonatal mortality if it were to adopt electronic medical records (EMRs), my colleague Professor Amalia Miller from the University of Virginia and I examined 12 years of birth and death records for all American counties. We combined these with national data on the adoption of EMRs by U.S. hospitals. Then we ran a regression analysis—a statistical technique for estimating the relationships among variables—to include controls for hospital and county characteristics.

We found that a 10 percent increase in basic EMR adoption would reduce neonatal mortality rates by 16 deaths per 100,000 live births. Beyond this, a 10 percent increase in EMR adoption plus the same increase in obstetric-specific computing technology would cut neonatal mortality by 40 deaths per 100,000 live births. We documented that this increase was driven by the kind of conditions that could be helped by detailed documentation, such as those stemming from difficulties during a pregnancy, rather than by conditions that EMRs were less likely to help, such as congenital defects and accidents. Our study provides cautious optimism about the potential value of healthcare IT and EMRs in improving neonatal health outcomes.

When studying technology-based healthcare improvements, one concern is whether they reinforce or reduce inequalities in healthcare outcomes. Therefore, a striking additional empirical finding was that the adoption of EMRs produced larger gains for historically disadvantaged groups, such as less educated mothers and black mothers.

Healthcare IT can play a role in standardizing care and ensuring that best practices are pursued in all cases.

“There is some evidence that these differences in outcomes reflect the differences in treatments offered to different groups. To the extent that healthcare IT systems reduce this variation in treatment decisions—by decreasing the burden on mothers to advocate for certain treatments and recalling past medical histories—they may improve outcomes for these historically disadvantaged groups.”

“Healthcare IT can play a role in standardizing care and ensuring that best practices are pursued in all cases.”
Our rough calculations suggest that EMRs are associated with a cost of $531,000 per baby saved. The estimated impact of basic EMR adoption is a reduction of 1.6 deaths per 1,000 live births. In other words: A complete national transition from paper to computer records could save as many as 6,400 infants per year, out of about 4 million births.

The cost of doing so is substantially lower than the cost of expanding Medicaid, which would cost $840,000 per infant life saved. By comparison, the Office of Management and Budget endorses values between $1 million and $10 million for a statistical life in cost-benefit evaluations. This indicates that spending money on this kind of healthcare IT is relatively cost-effective.

Our findings suggest that investing in healthcare IT, and specifically in EMRs, is an effective way to improve neonatal health outcomes. EMRs have the potential to standardize treatment options, which can improve mortality rates for babies born to mothers of historically marginalized groups. They also represent a cost-effective investment for hospitals. These findings offer support for current health policy that is directed toward increasing the usage of EMRs and other technologies.●●●
There is growing consensus that the bench-to-bedside process of translating biomedical research into effective therapeutics is broken. In a paper published in the October 2012 issue of *Nature Biotechnology*, my coauthors, Jose-Maria Fernandez and Roger M. Stein, and I suggest that this is caused in large part by the trend of increasing risk and complexity in the biopharma industry. This trend implies that the traditional financing vehicles of private and public equity are becoming less effective for funding biopharma because the needs and expectations of limited partners and shareholders are becoming less aligned with the new realities of biomedical innovation. The traditional quarterly earnings cycle, real-time pricing, and dispersed ownership of public equities imply constant scrutiny of corporate performance from many different types of shareholders, all pushing senior management toward projects and strategies with clearer and more immediate payoffs, and away from more speculative but potentially more transformative science and translational research.

We propose a new framework for simultaneously investing in multiple biomedical projects to increase the chances that a few will succeed, thus generating enough profit to...
more than make up for all the failures. Given the outsized cost of drug development, such a “megafund” will require billions of dollars in capital; but with so many projects in a single portfolio, our simulations suggest that risk can be reduced enough to attract deep-pocketed institutional investors, such as pension funds, insurance companies, and sovereign wealth funds.

A key innovation of this proposal is to tap into public capital markets directly through securitization, using structured debt securities as well as traditional equity to finance the cost of basic biomedical research and clinical trials. Securitization is a common financing method in which investment capital is obtained from a diverse investor population by issuing debt and equity that are claims on a portfolio of assets—in this case biomedical research. Debt financing is an important feature because the bond market is much larger than the equity market, and this larger pool of capital is needed to support the size of the portfolios required to diversify the risk of the drug development process. In addition, this vast pool of capital tends to be more patient than the longest-horizon venture capital fund.

Our findings suggest that bonds of different credit quality can be created, which could appeal to a broad set of short-term and long-term investors. The results from the simulations we ran indicate that a megafund of $5 billion to $15 billion may be capable of yielding average investment returns in the range of 9 percent to 11 percent for equity holders, and 5 percent to 8 percent for bondholders. These returns may be lower than traditional venture capital hurdle rates, but are more attractive to large institutional investors.

To calibrate and test our simulation of the investment performance of a hypothetical cancer drug megafund, we accessed the databases of hundreds of anti-cancer compounds assembled by Deloitte Recap LLC and the Center for the Study of Drug Development at Tufts University School of Medicine. These simulations not only yielded attractive investment returns on average, but also implied that many more drugs would be successfully developed and brought to market. Such an outcome would be particularly welcome given the current scarcity of investment capital in the life sciences industry despite the growing burden of disease. One in two men and one in three women in the United States will develop cancer at some point in their lifetimes, making this one of the major priorities facing society.

We acknowledge that our analysis is only the first of many steps needed to create a private-sector solution to the funding gap in the life sciences industry. The practical challenges of creating a megafund would require unprecedented collaboration among medical researchers, financial engineers, and biopharma practitioners. Support from charitable organizations and the government also could play a critical role in expediting this initiative. In an extension of this simulation, we show that the impact of such support can be greatly magnified in the form of guarantees rather than direct subsidies. The MIT Laboratory for Financial Engineering will be hosting a conference at MIT in June where representatives from all the major stakeholder communities will be invited to explore these ideas together.

Finally, our proposal is clearly motivated by financial innovations that played a role in the recent financial crisis, so it is natural to question the wisdom of this approach. Despite Wall Street’s mixed reputation in recent years, we are convinced that securitization can be used responsibly to address a host of pressing social challenges. With lessons learned from the crisis and proper regulatory oversight, financial engineering can generate significant new sources of funding for the biopharma industry, even in this difficult economic climate. Raising billions of private-sector dollars for biomedical research may seem ill timed and naive—but given the urgency of cancer, diabetes, heart disease, and other medical challenges, the question is not whether we can afford to invest billions more at this time, but rather whether we can afford to wait.

“We propose a new framework for simultaneously investing in multiple biomedical projects to increase the chances that a few will succeed, thus generating enough profit to more than make up for all the failures.”
Eyes on the Grand Innovation Prize
Fiona E. Murray

Grand Innovation Prizes (GIPs) are large monetary rewards set up by governments and private institutions to stimulate radical breakthroughs that solve society’s most pressing problems. They have existed for centuries: In the 1790s, the British Parliament rewarded Edward Jenner for his vaccine inoculation; in the early 1800s, it rewarded Henry Gateshead for the lifeboat. After falling out of fashion, prizes made a brief return to prominence at the start of the 20th century when Charles Lindbergh won the 1927 $25,000 Orteig Prize (established by the wealthy New York hotelier), for becoming the first aviator to fly nonstop from New York to Paris. However, for most of the 20th century, governments and others concerned with ensuring a robust stream of innovation breakthroughs relied on market-based rewards, such as patents, or on procurement and grant programs.

Over the past 17 years, GIPs have re-emerged, initiated in part by the success of the $10 million Ansari X PRIZE, which was established in 1996 by the X PRIZE Foundation to reward the first private vehicle to launch a reusable manned spaceship into space. In 2004, Spaceship One—funded by Microsoft co-founder Paul Allen—was declared the winner.

Recognizing the role of government in the prize landscape, President Barack Obama released the 2009 Strategy for American Innovation, which was closely followed by a

Fiona Murray is the David Sarnoff Professor of Management Technology; an Associate Professor of Technological Innovation, Entrepreneurship, and Strategic Management; and the Faculty Director of the Martin Trust Center for MIT Entrepreneurship.
“Despite their growing popularity, little is known about whether GIPs are effective.”

Despite their growing popularity, little is known about whether GIPs are effective. Do they provide the right incentives to galvanize the innovator community? Do they justify the considerable costs incurred by participants who compete in the contests? And finally: How might future competitions be improved?

To find out, my colleagues at MIT Sloan and Harvard Business School and I studied the Progressive Insurance Automotive X PRIZE (PIAXP), a $10 million prize for a highly efficient passenger vehicle. We attended PIAXP events, carried out interviews with participating teams, and gathered survey data. In addition, we conducted interviews with the X PRIZE Foundation staff in charge of administering the competition, contest designers, and judges. Our key findings include:

• **GIPs meet more multifaceted goals than anticipated in theoretical analysis.** Both prize organizers and advocates say that the goals of GIPs transcend simply solving problems. The contests also stimulate education, participation, and community building. They can deliver reputational benefits to participants, sponsors, and organizers as well as focus significant attention on major issues through the marketing and publicity they enable. These benefits can be as important as the technical solutions themselves. Paradoxically, prizes can be successful even when they do not yield a “winner” by traditional standards.

• **Design specifications for GIPs are complex.** Contemporary GIPs are complex departures from some of the simpler competitions of the past that involved individuals solving relatively narrow problems. The difficult nature of the PIAXP goal—for example, a safe, highly energy-efficient car that can be economically manufactured and the systemic nature of the innovations required to solve this and other grand challenges—necessitates that judges assess multiple dimensions of performance. Some of these dimensions can be hard to quantify or may be unanticipated, while others may change as the competition unfolds.

If design specifications are done poorly, they will bias competition in favor of certain technical choices and away from others.

• **Incentives are more nuanced than recognized by theorists.** A variety of non-prize incentives are just as important to participants as the prize money, many of which can be gained by the teams regardless of whether or not they “win.” Some of these incentives—the publicity, attention, and credibility, or the education provided by the prize platform—can ultimately improve team performance. Others, such as community building, are social in nature.

• **Prize governance is critically important.** Just like patents, procurements, and grants, prizes require good governance and management designed to suit the specific prize and its objectives. This is a more costly and time-consuming endeavor than many prize organizers initially realize. Given the difficulties in identifying all that can happen throughout the duration of a complex competition, rule modifications and adaptations along the way are to be expected—and these must be handled in a way that respects participants who are committed to the effort. “Thin” institutional arrangements leave prize organizers vulnerable to disputes over the structure or fairness of GIP awards.

Our results suggest that GIPs cannot be viewed as a simple incentive mechanism through which governments and others stimulate innovation where markets have failed. Rather, they are best viewed as a novel type of organization in which a complex array of incentives is orchestrated within the context of a thoughtful governance system in order to enable successful innovation and encourage innovators and entrepreneurs. We hope that our research offers guidance to organizers and advocates as they attempt to spur groundbreaking solutions to problems that lie beyond traditional means.
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Champion faculty: Support the creative collaboration, inventive curricular advancements, and cutting edge research amongst our academic stars. (pp. 9–12)

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Can the impending digital revolution work out for everyone? Two of MIT Sloan’s leading thinkers want to ensure it does.

By Zach Church
The story isn’t new to anyone familiar with the basic gripe behind both the Tea Party and Occupy Wall Street movements. Spurred on by incredible advancements in technology, the U.S. economy has grown in both productivity and gross domestic product. Meanwhile, employment and median income have stagnated, and jobs and money are increasingly harder to come by due to population growth. Erik Brynjolfsson and Andrew McAfee, authors of *Race Against the Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy*, expect that this “great decoupling,” underway for two decades, will only become larger.

So that’s bad, right? Well, only half so.

Brynjolfsson and McAfee have been studying what happens to economies, organizations, and labor as technological innovation follows Moore’s law to the hilt. But where others see impending disaster, they see encouraging growth. As the leaders of MIT Sloan’s new Initiative for the Digital Economy, they believe that inventing organizations and institutions that complement this new digital-era economy is a grand challenge for our times. With the initiative, they are issuing that challenge to their colleagues and contemporaries.

“There’s no economic law that says when technology creates wealth, it also automatically creates the same number of jobs or that everybody benefits evenly,” says Brynjolfsson, the director of the MIT Center for Digital Business, the Schussel Family Professor of Management, and chair of MIT Sloan Management Review. “We’ve been lucky that’s more or less what happened for most of the past hundred years, but there’s no guarantee it’s going to happen going forward.”

“What happens to the median worker is something that will depend on our ability to innovate on other dimensions, like economic institutions and inventing new industries and new business models,” he says. “So far, our technologist friends at MIT have been doing a great job, and it’s time for us to step up at the business school to keep up with them. We need to invent new economic institutions, new industries, new business models, and new ways of organizing work that will thrive in this emerging world of accelerating technology.”

And here’s where Brynjolfsson and McAfee break away from peers like George Mason University’s Tyler Cowen, whose 2011 book, *The Great Stagnation: How America Ate All the Low-Hanging Fruit of Modern History, Got Sick, and Will (Eventually) Feel Better*, argued that technological innovation has fallen off and will not drive new wealth, and Northwestern University’s Robert Gordon, whose August 2012 paper, “Is U.S.
Economic Growth Over? Faltering Innovation Confronts the Six Headwinds,” inspired significant discussion. Brynjolfsson and McAfee describe themselves as digital optimists. They believe not only that technological innovation has not and will not stagnate, but that it can also mean a better economy and a better society for everyone.

A portfolio of astounding achievement.

This is a decidedly optimistic take on the future. It comes from a pair who rode in Google’s self-driven car, who watched as IBM’s Watson supercomputer wiped the floor with MIT Sloan and Harvard Business School students in a Jeopardy! match, and who meet regularly with leading scientists working in robotics and artificial intelligence. The enthusiasm coursed through McAfee’s TEDxBoston talk last summer. (“We ain’t seen nothing yet,” he told the audience, and it’s clear he can’t wait until we do.) Told that 3D printers can now create LP records—a relatively consumerist, non-essential achievement—McAfee simply remarks, “Wow.” These guys see it all, and yet news of an incremental advancement rouses them. They have no reason to be surprised, yet see every reason to be excited.

“The Google car by itself is probably a trillion-dollar innovation,” says Brynjolfsson. “The self-driving car is going to have that kind of impact on the economy. So far, it’s a tiny fraction of that. And you go through the other emerging technologies: what Watson’s ability to answer questions is going to do not just for call centers, but also for medical diagnosis and legal research. The numbers start adding up in a pretty staggering way. And these are just for the ones that we’ve actually seen and tried out. The impact will be that much larger when you consider the ones on the drawing board that are still to come.”

That sort of technological advancement comes in all sizes and is constantly underway at MIT and MIT Sloan. Brynjolfsson and McAfee see it in their own work. With an MIT Sloan doctoral candidate, Brynjolfsson crunched mountains of publically available search data to build a housing sales predictor that outshone the leading models in the industry. And that was in 2009. McAfee recently studied the effect of new monitoring technology in restaurants, allowing managers to judge employee performance and improve loss prevention. The revenue implications, he says, are significant.

Both the housing sales and restaurant-monitoring cases are just that: case studies. They are encouraging—each foretells a technology-driven shift in industry standards that would add...
value without necessarily cutting jobs or wages. However, they really start to become significant when viewed not only in the aggregate, but also as part of a new era in technological and economic development. That’s the era Brynjolfsson and McAfee want economists, business leaders, engineers, and scientists, working together, to lead the country toward.

“This is a great world that we’re heading into,” says McAfee, who is associate director and principal research scientist at the MIT Center for Digital Business. “This is not some apocalyptic or dire scenario. Erik and I firmly believe that we’re not heading into an economy where there’s not enough to go around. What this technology bundle is doing is bringing us into a more bountiful, more abundant world.”

“But getting from here to there is very disruptive,” Brynjolfsson adds. “Just doing business as usual and relying on the same kind of economic institutions will become increasingly dysfunctional. So we have to manage that transition. If we don’t manage it, there could be a lot of people who are left behind, at least temporarily. That’s bad for them, and, frankly, it’s bad for everybody.”

So here are some of the MIT players who might be involved: MIT Sloan’s top-rated Information Technology group along with its leading Finance, Organization Studies, and Technological Innovation, Entrepreneurship, and Strategic Management groups; the vaunted and interdisciplinary MIT Media Lab; the Computer Science and Artificial Intelligence Laboratory, known as CSAIL and home to some of the world’s top artificial intelligence (AI) researchers; Brynjolfsson and McAfee’s MIT Center for Digital Business; and MIT’s Economics department, where the faculty and alumni roster is dotted with the names of Nobel Laureates. And those are just the obvious participants, and only the ones at MIT.

“What we want to do with this initiative is bring those people together to get that dialogue going and have it be very explicit, where the AI researchers tell the economists what’s doable,” Brynjolfsson says, “and the economists talk to the roboticists about the implications of their technologies, and we work together with a discussion that could not happen any other place in the world.”

And then there is the possibility for input from industry leaders, among whom interest in the new digital economy is high. A recent MIT Sloan alumni event hosted by Brynjolfsson and McAfee in San Francisco included guest speakers like O’Reilly Media founder Tim O’Reilly, TIBCO founder Vivek Ranadivé, and Rethink Robotics founder Rodney Brooks.

It all adds up to a lot of smart people capable of reshaping the way economies and industries function, along the way ensuring that work, employment, and livable wages remain a reality of American life.

“Ultimately, all these technologies aren’t going to be valuable unless they help people,” Brynjolfsson says. “It’s one thing to have a machine that does wondrous things—but unless it creates economic value and helps society, what’s the point?”

A new initiative, a grand challenge.

A nd that’s where the Initiative for the Digital Economy comes in. A major effort from MIT Sloan, the initiative addresses the impact of technology on businesses, the economy, and society. The way Brynjolfsson sees it, the engineers and scientists across campus have brought us to this brave new world. It’s time for the business and management side of MIT to make it work for society.

“We need to invent the economics and the social system that can keep up with what they’re doing on the technology side,” he says. “We need to come up with a system that will find jobs for the people whose tasks can now be done by computers or, better yet, leverage them into doing something that could never have been done before.”
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