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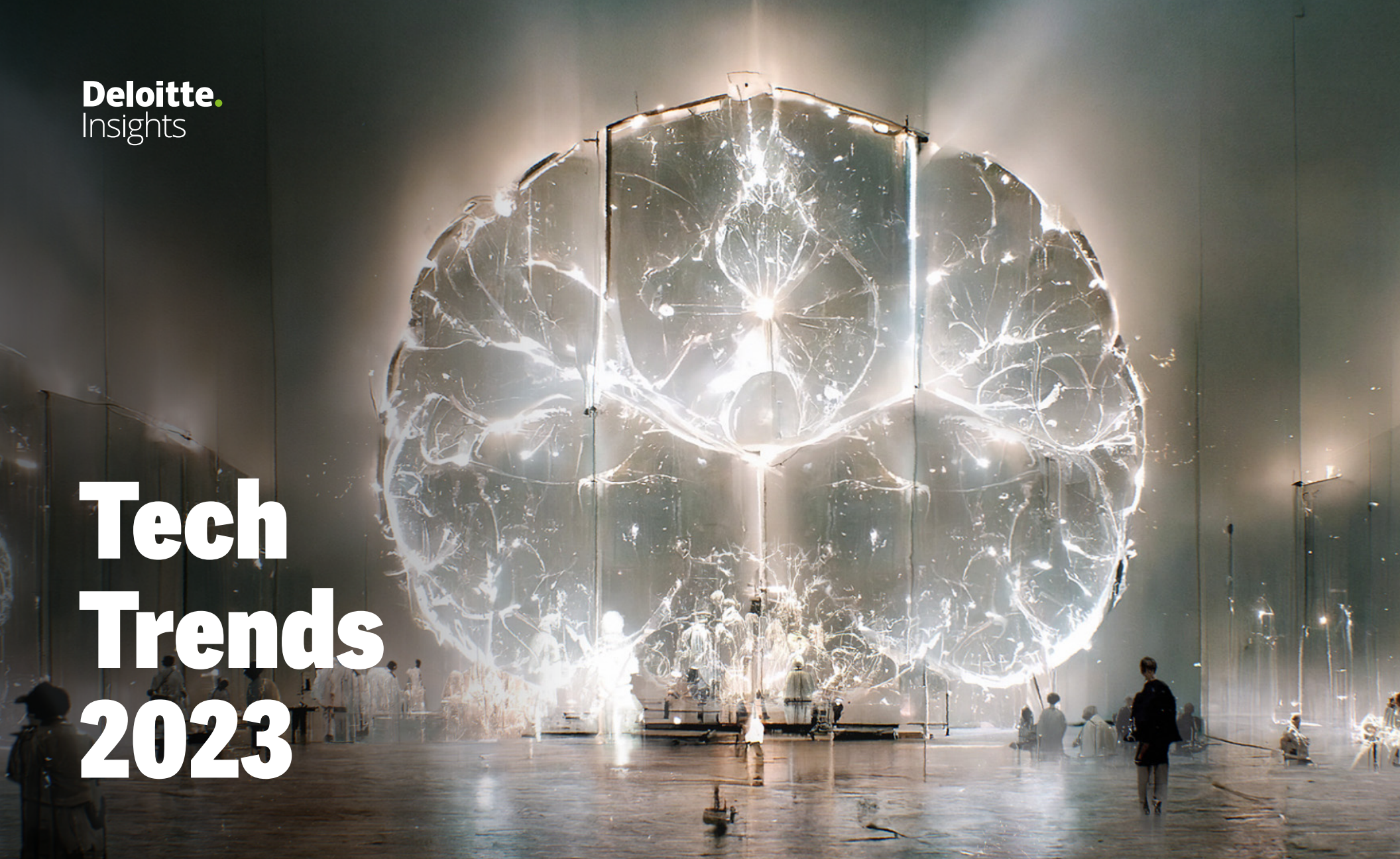
Tech Trends 2023



Epilogue

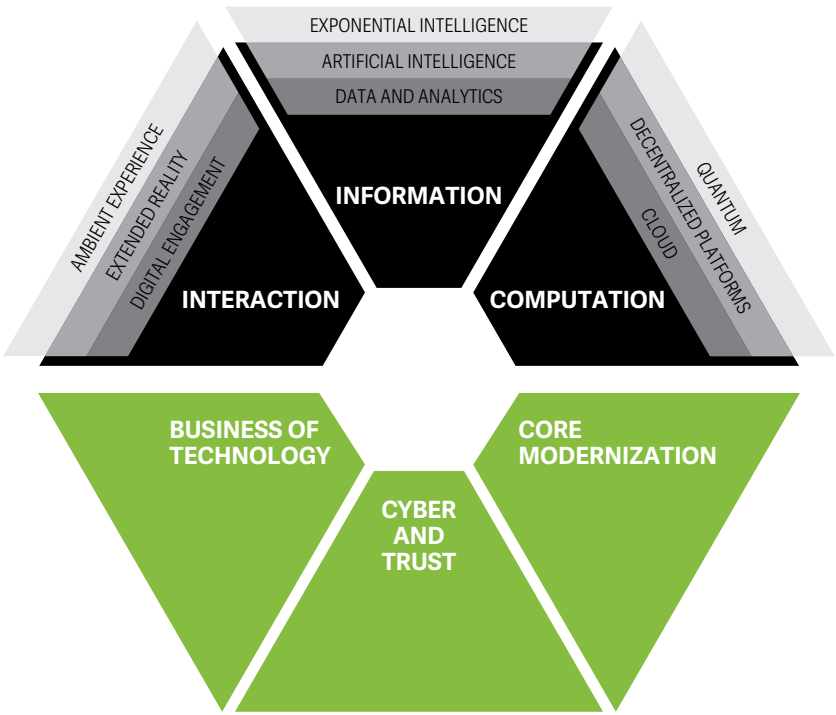
Widening the aperture: From infoTech to xTech

Since 2010, when our *Tech Trends* team began researching how emerging technologies are transforming and disrupting business in exciting and unpredictable ways, we've talked with hundreds of business and technology leaders. Through our conversations with these innovators, we developed—and continue to fine-tune—our macro forces framework, as we discussed in the **prologue** (figure 1).

These same conversations are also teaching us the limits of the macro forces framework. Historically, to enterprise audiences, "technology" has served as shorthand for *information* technology. Increasingly, however, pioneering leaders are drawing our attention to an extended set of technologies—or *xTech*—that, to date, have been separate and distinct from enterprise IT. Spurred by our clients' experiences, we sought to define *x*.

Our team of futurists went prospecting for potential futures. We drink our own champagne here at Deloitte, so we embarked on a principled exploration of emerging tech horizons, as described in the *Tech Trends 2020* chapter **Horizon next**.[1] For inspiration, we turned to the sciences. After all, information technology is rooted in the formal sciences (figure 2).

FIGURE 1: Six macro forces of information technology



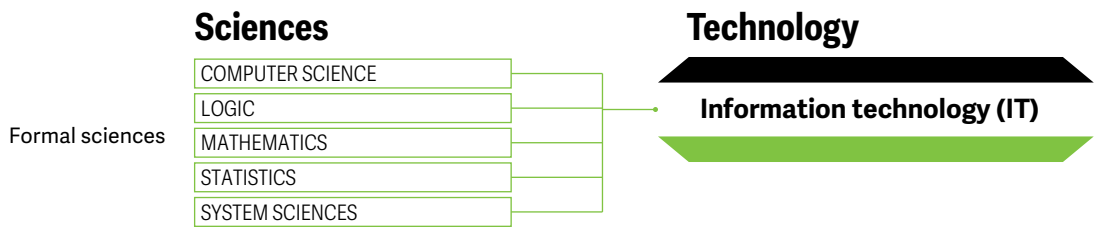
Source: Deloitte analysis.

Through a process of sensing, scouting, and scanning[2], we widened the aperture by surveying natural and social sciences, the scientific disciplines adjacent to the formal sciences. In search of xTech, we explored trends in R&D in these academic and research areas, and found some signals among the noise (figure 3).

We monitored patent and startup activity, technology maturity and advancements, academic and grant investments, and venture capital funding. We also looked at talent trends to identify the industries and sectors attracting the best and brightest professionals and grads.

In dissecting the data, we found that a handful of distinct IT-adjacent categories are snagging the lion's share of talent and treasure. The technologies in each of these categories look to solve fundamental quality-of-life challenges and constraints. We expect these six emerging technology disciplines to eventually rival IT in their impact on business innovation (figure 4).

FIGURE 2: The scientific roots of IT



Source: Deloitte analysis.

SpaceTech: Space and aeronautical engineering

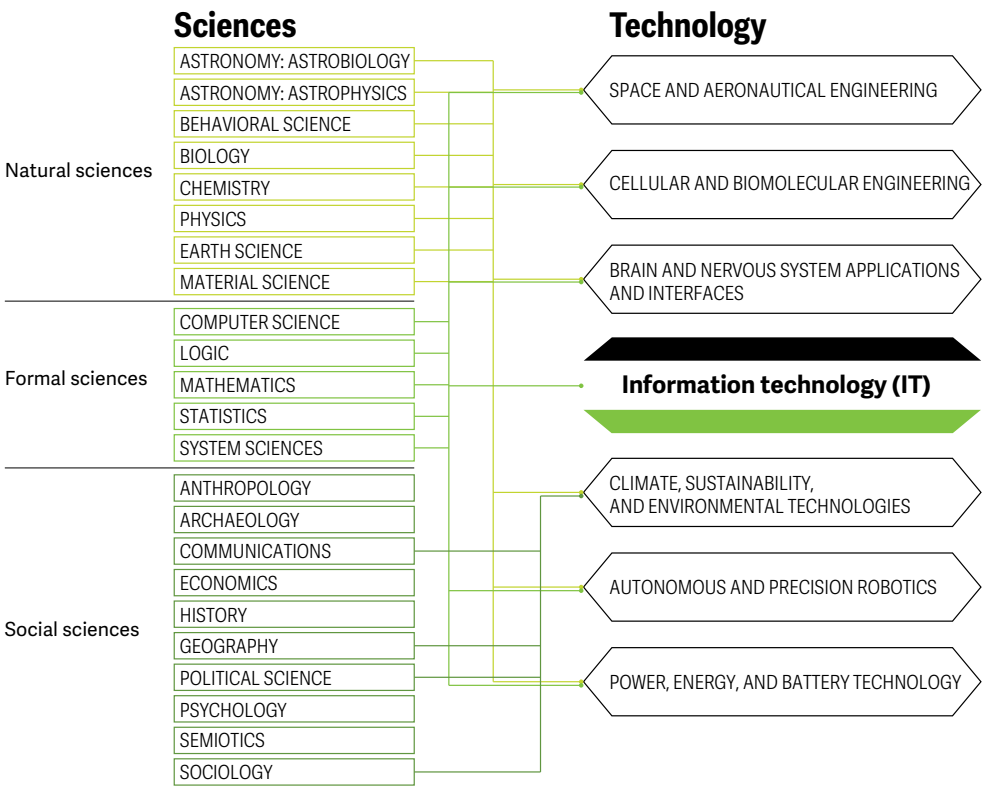
Once the exclusive province of government entities, space and aeronautical engineering has quickly become a vibrant enterprise opportunity, with government space agencies turning over many aspects of space flights, launches, and operations to private companies over the last couple of decades. Private industry investment in transportation and applications in low-Earth orbit (LEO)—Earth-centered orbits with an altitude of 2,000 kilometers (1,200 miles) or less—is flourishing, particularly as NASA's focus has evolved to deep space exploration,[3] launch costs have decreased, and companies begin to understand the benefit of space technologies and discoveries to life here on Earth.

The commercialization and industrialization of LEO, where the International Space Station is located, includes the so-called space-for-Earth economy—goods and services produced in space for use on Earth, such as communications infrastructure, earth observation capabilities, and national security satellites[4]—as well as in-orbit servicing, assembly, and manufacturing; commercial launch services and ground systems; scientific research and development; and commercial human spaceflight.

BioTech: Cellular and biomolecular engineering

Sitting at the convergence of biology and engineering, the field of cellular and biomolecular engineering provides the ability to deconstruct and architect cells, tissues, and molecules, rather than relying on natural selection to produce optimal outcomes. Insight into complex biological systems—plants, animals, and even people—at the molecular scale has already resulted in the complete sequencing of the human genome as well as

FIGURE 3: Toward xTech



Source: Deloitte analysis.

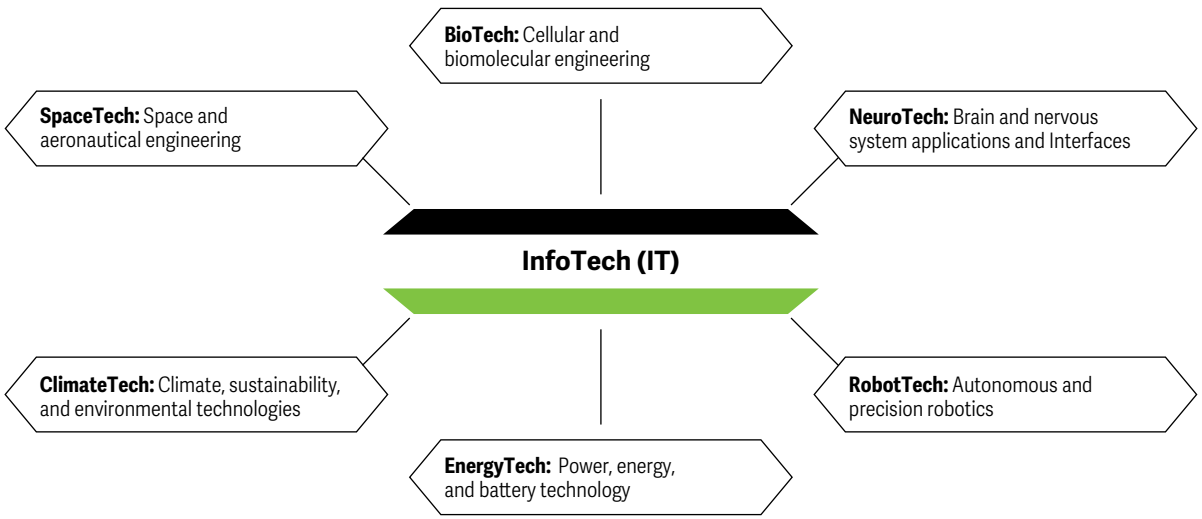
tissue-engineered products used for therapeutic purposes.[5]

The introduction of nanotechnologies, precision manufacturing robotics, and DNA modularity have fueled recent advancements and applications in biosensing, therapeutics, biofuels, pharmaceuticals, vaccines, synthetic food, pollutant-cleaning microbes, and biological data storage. Technology areas ripe for commercialization include synthetic biology, the process of creating or redesigning biological parts and systems and developing synthetic life forms; genomics, the function and editing of genomes; and cellular agriculture, the production of synthetic food using cell cultures and new ways of generating proteins, fats, and tissues.

NeuroTech: Brain and nervous system applications and interfaces

Brain and nervous system applications and interfaces, also known as brain-computer interfaces (BCIs) can help remove the friction between humans

FIGURE 4: From infoTech to xTech



Source: Deloitte analysis.

and technology by translating brain signals (thoughts) into commands and enabling humans to perform physical actions. BCIs measure the activity of the brain and central nervous system and translate it into commands that can control external software or hardware systems. They have the potential to make controlling computers as natural as thinking.

In the near term, BCIs will be used for assistive technologies; in the long term, for revolutions in human-computer interaction. Today's state-of-the-art technology features noninvasive EEG electrodes that relay brain signals to AI-trained algorithms, which predict the meaning of the signal and transmit commands to control a device. R&D is primarily focused on restorative, therapeutic, and assistive applications for people with paralysis or other disabilities. Future applications could include elective placement of BCIs that could help humans enhance their thinking, capabilities, and skills.

RobotTech: Autonomous and precision robotics

Autonomous and precision robots extend the value of AI applications from software-based decision-making systems to physical robots and machines that can make decisions and complete movement-based actions. An autonomous robot can scan and understand its surroundings and figure out where to go and what to do, without any special physical infrastructure. This includes autonomous cars and trucks and micromobility options, such as bikes, scooters, and small delivery vehicles. Precision robots are dexterous, multifunctional, and intelligent robots used to complete highly specific and exacting actions in industrial, agricultural, marine and space exploration, and medical and surgical applications.

Autonomous and precision robotics advancements include those in traditional manufacturing, cobot automation, autonomous transportation, logistics, process virtualization, and optimization. This domain will be supported by adjacent advancements in AI, interconnectivity of Internet of Things smart devices, edge computing, digital twins, remote operation, satellite and 5G communications, and advanced materials.

ClimateTech: Climate, sustainability, and environmental technology

Climate change is proving to be one of the most intractable issues of our time. In response to the climate crisis, many businesses are prioritizing net-zero policies and business models. Technology could be the most powerful weapon in the net-zero arsenal. "Technology is part of the [climate] solution, not part of the problem," says Inger Andersen, executive director of the United Nations Environment Program."[6]

Relevant climate technology areas include renewable energy, decarbonization, sustainable material development, heat abatement technologies, and supply chain optimization. Digital technologies,

too, can play a viable role. For example, solutions leveraging IoT, AI, and big data can help organizations measure, analyze, and track carbon emissions. And advances in sensors, robotics, and AI are helping businesses (and consumers) manage energy use more efficiently.

EnergyTech: Power, energy, and battery technology

Many power, energy, and battery technologies can help lessen the impact of climate change, but we categorize them separately from climate technologies because others simply help make energy more abundant, safer, or less expensive.

For example, advancements in nanotechnology and materials are helping to improve battery life for vehicles and phones and to reduce dependence on infamously scarce and hard-to-obtain materials such as cobalt and lithium. And energy storage solutions such as pumped storage hydropower and flywheel energy storage can help stabilize energy grids, make them more efficient, and ensure that energy isn't wasted.

What's next?

Given the emergence—and the importance—of these IT-adjacent technology domains, to continue to focus solely on IT would be to ignore a broad spectrum of potentially transformational business applications on the next technological horizon. What does all of this mean for *Tech Trends*? Our flagship report will remain focused on IT, but it will be joined shortly by a series of *Tech Futures* reports that will consider these exciting emerging technological frontiers. In our first issue, we'll take a look at the "what," "so what," and "now what" stemming from pioneering advancements in space systems and aeronautical engineering.

Coming soon: *Deloitte Technology Futures: Space-Tech*. Scheduled for launch in mid-2023.

See you in the future.

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Endnotes

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Acknowledgments

Our insights can help you take advantage of emerging trends.

If you're looking for fresh ideas to address your challenges, let's talk.

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The NExT team

The Novel and Exponential Technologies (NExT) team is a team of futurists and researchers that senses—and makes sense of—emerging technologies that have the potential for widespread business impact. With our pragmatic approach to futurism, we help organizations shape strategic business agendas and set an intentional course toward tomorrow.

If you'd like to connect and discuss more, please feel free to contact us at usNExTteam@deloitte.com.

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As chief futurist with Deloitte Consulting LLP, Mike Bechtel helps clients develop strategies to thrive in the face of discontinuity and disruption. His team researches the novel and exponential technologies most likely to impact the future of business, and builds relationships with the startups, incumbents, and academic institutions creating them.

Prior to joining Deloitte, Bechtel led Ringleader Ventures, an early stage venture capital firm he cofounded in 2013. Before Ringleader, he served as CTO of Start Early, a national not-for-profit focused on early childhood education for at-risk youth. Bechtel began his career in technology R&D at a global professional services firm, where his dozen US patents helped result in him being named that firm's global innovation director. He currently serves as professor of corporate innovation at the University of Notre Dame.

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